



Roads &
Maritime

Nest Box Management Plan (Sections 4 & 5)

Woolgoolga to Ballina Pacific Highway upgrade

October 2014

<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>	<i>Reviewed By</i>
2321-1009	First issue (draft)	09/04/2014	DGH	DSA
2321-1112	Second issue (final)	21/08/2014	DGH	RMS
2321-1116	Third issue (final)	12/09/2014	DGH	RMS
2321-1127	Fourth issue (final)	31/10/2014	DGH	RMS



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Introduction

1.1 Background

GeoLINK has been engaged by the NSW Roads and Maritime Services (RMS) to undertake hollow-bearing tree (HBT) surveys for Sections 4 and 5 of the Woolgoolga to Ballina (W2B) Pacific Highway upgrade project and to prepare a Nest Box Management Plan (NBMP) to offset the loss of HBTs for this project. The W2B project comprises approximately 155 kilometres of highway achieving a four-lane divided road extending north of Woolgoolga to south of Ballina. Section 4 of this project is approximately 13.2 kilometres and would involve a deviation approximately 800 metres to the east of the existing highway, which would be built to full motorway standard (Class M). This section would start at the Tyndale interchange and continue north to join the existing highway at the Maclean interchange. Section 5 of the project is approximately 14.4 kilometres starting at the Maclean interchange and ending at the Iluka Road interchange at Woombah. This section would be a duplication of the existing Pacific Highway alignment, with most of the highway upgraded to motorway standard (Class M).

The location of Sections 4 and 5 are shown in **Illustration 1.1**.

1.2 Purpose of this Report

Tree hollows are essential for a wide range of fauna which are dependant on tree hollows for nesting and roosting habitat. The presence, abundance and species richness of hollow-using fauna are correlated with the density of hollow-bearing trees in a wide range of studies (e.g. Gibbons and Lindenmayer 2002, Kavanagh and Wheeler 2004). For these reasons, the loss of hollow-bearing trees is currently listed as a Key Threatening Process (KTP) under the *Threatened Species Conservation Act* (TSC Act) and requires mitigation measures to ameliorate this impact.

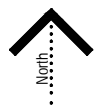
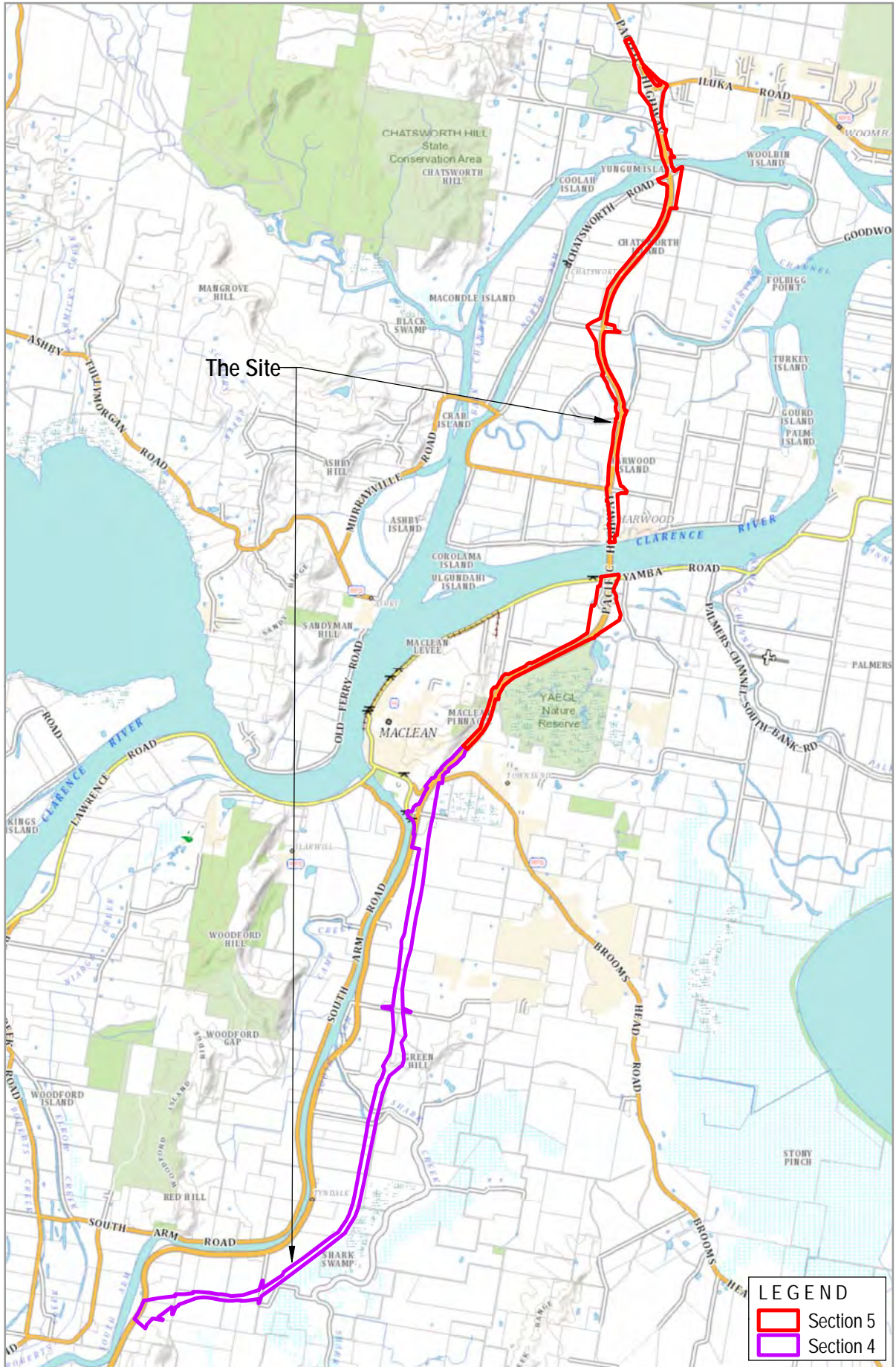
This report addresses Mitigation Measure B37 stated within the W2B Environmental Impact Statement (SKM, 2013 (EIS) that:

"Nest boxes would be installed as per RMS Biodiversity Guidelines (RTA, 2011a) and a nest box strategy developed as part of the CEMP detailing:

- *The number and type of nest boxes required based on the number, quality and size of the hollows that would be removed.*
- *Specifications for nest box dimensions, installation requirements, locations of nest boxes and ongoing monitoring and maintenance.*
- *Installation timeframes including the installation of 70% of nest boxes prior to the removal of any vegetation."*

The purpose of this report is to document the findings of HBT surveys undertaken for Sections 4 and 5 of the W2B project and propose an offset strategy involving the installation, maintenance and monitoring of nest boxes to mitigate the loss of HBTs.

An objective of this report is to provide for a consistent approach to nest box management to that used on recent Pacific Highway upgrade projects. Accordingly the methodology used for this report is based on that used by Lewis (2013) and the *RMS Biodiversity Guidelines* (2011).



0 2 km

Methodology

2.1 Hollow Bearing Tree Survey

2.1.1 Methods

A hollow-bearing tree (HBT) survey of all areas within the project boundary and a 10 metre buffer was undertaken for Sections 4 and 5 by two experienced ecologists (David Havilah and David Andrighetto) between 25 February 2014 and 5 March 2014. In total more than 130 person hours were spent undertaking the HBT surveys and vegetation surveys for this project.

The location of all HBTs was recorded in the field using a GPS with all HBTs marked in the field using red and white flagging tape and a ring of white spray paint. A code was given to each HBT (e.g. 3H1, 3H2, 3H3, etc) which was also spray painted on each HBT. The following data was collected for each HBT:

- Tree species.
- Whether the tree was dead or alive.
- Estimate of height.
- Diameter at breast height (DBH).
- Approximate number of hollows per tree.
- Position of hollows in the tree (i.e. trunk, limb).
- Estimated size class of hollows (Small=<50 mm; Medium=50-150 mm; Large>150 mm).

2.1.2 Parts of the Site Not Accessed

Due to private property access limitations a number of areas were unable to be accessed at the time of survey. These areas are shown in **Illustrations 2.1 to 2.6**. While most of these areas were within areas currently under cultivation for Sugar Cane a number of areas contain areas of native vegetation, the most notable of these being in the vicinity of Iluka Road.

2.1.3 Reference Sites

In line with the methodology used by Lewis (2013), 10 one hectare reference sites were established outside of the project boundary. The location of these reference sites was generally selected to coincide with areas of HBTs occurring within the clearing footprint and was aimed at providing more context on the type and availability of hollow resources within the general areas where HBTs are to be removed. The location of these reference sites is shown in **Appendix A**. The location of all HBTs and data outlined in **Section 2.1.1** was recorded for each reference site.

2.2 Nest Box Management Strategy

2.2.1 Replacement Nest Box Zones

The aim of providing nest boxes as a mitigation measure is two-fold:

- To provide offsets for the permanent loss of habitat (HBTs) removed as part of a project.
- To provide alternative, immediate habitat for fauna displaced during clearing activities.

Recent Nest Box Management Plans (e.g. Lewis, 2013) have broadly required nest boxes in areas of appropriate habitat outside the project clearing footprint that have HBT densities of less than four per hectare.

Building upon this methodology, the following additional criteria for nest box areas have been used for this project:

1. A replacement nest box zone is to be established adjacent to an area where >five HBTs are to be removed or where fauna presence has been confirmed during pre-clearing surveys.
2. A nest box replacement zone is to be established in similar habitat to that where HBTs are to be removed.
3. Land tenure has been taken into account in deciding upon nest box zones.

2.2.2 Nest Box Numbers

In order to determine the number of nest boxes required for each nest box replacement zone, the following formula was firstly applied (Lewis, 2013):

A x B x 1.2 = Proposed number of nest boxes required

A = $\frac{\text{Number of identified HBTs within the clearing footprint of a specified area}}{\text{Area (ha) of vegetated land identified for removal}}$ = Density HBT/ha

B = $\frac{\text{Total number of tree hollows identified}}{\text{Total number of HBTs within the area}}$ = Mean number of functional hollows per HBT

1.2 = 20% error factor* built in to accommodate for the difficulties associated with identifying tree hollows in habitat with one or more of the following factors:

- Dense lower or mid stratum.
- Particular tree species (i.e. Broad leaved Paperbark) that are difficult to accurately critique for tree hollows.
- Adverse weather conditions when surveys had to be completed.

* Error factor to be adjusted to suit habitat, area surveyed and confidence of results.

The proposed number of nest boxes required for each specified area was rounded up to the nearest whole number.

RMS Biodiversity Guidelines generally prescribe that for replacement nest boxes, a ratio of 1:1 (hollows removed: nest boxes provided) is appropriate. Where nest box calculations using the above formula have been determined to be less than an approximate ratio of 1:1, nest box numbers have been increased to more closely reflect a ration of 1:1. In deciding on the final number of nest boxes to be installed consideration was also given to potential species competitive interactions and negative impacts associated with nest box oversupply.

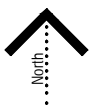
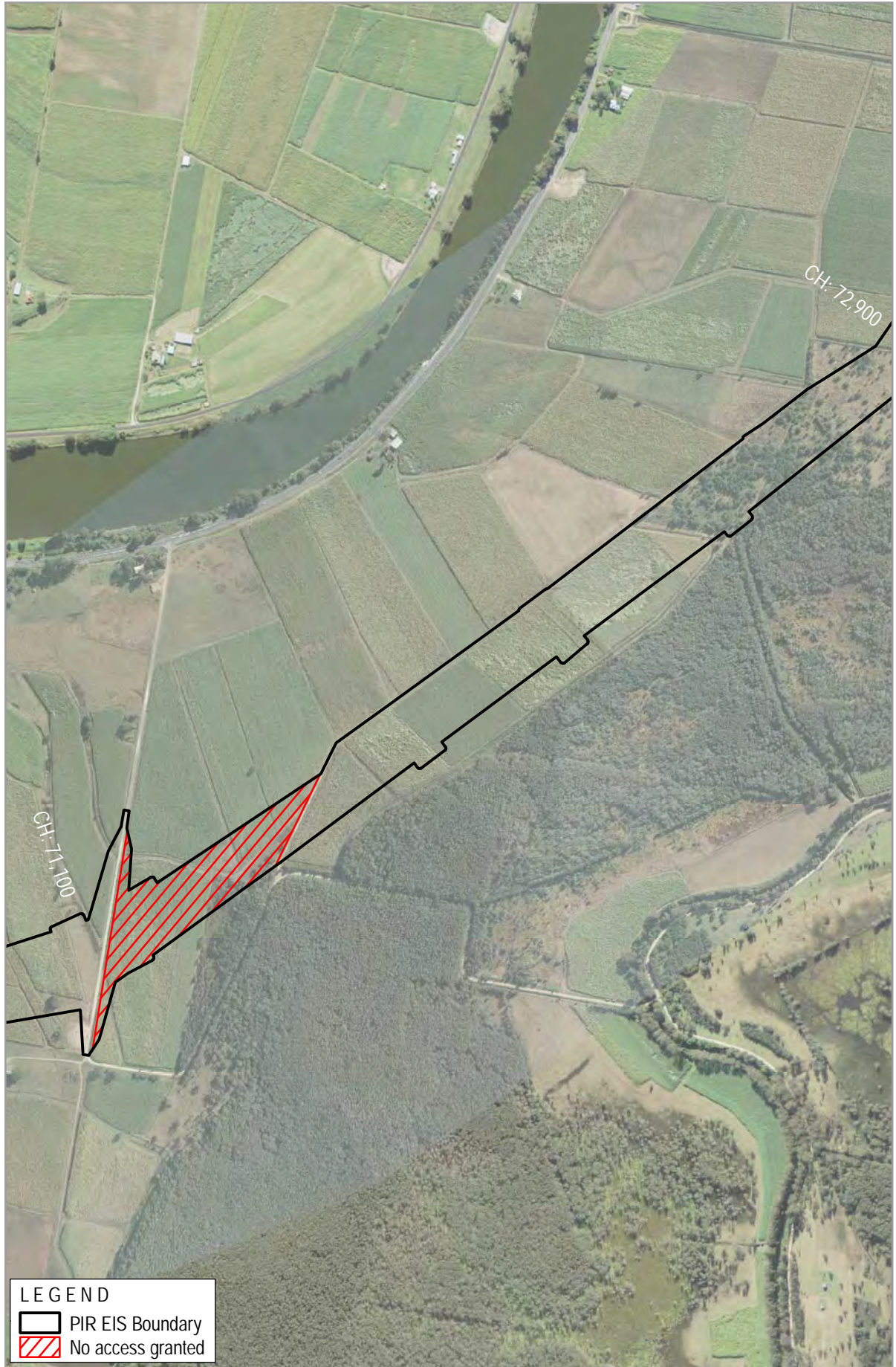
2.2.3 Nest Box Types

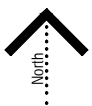
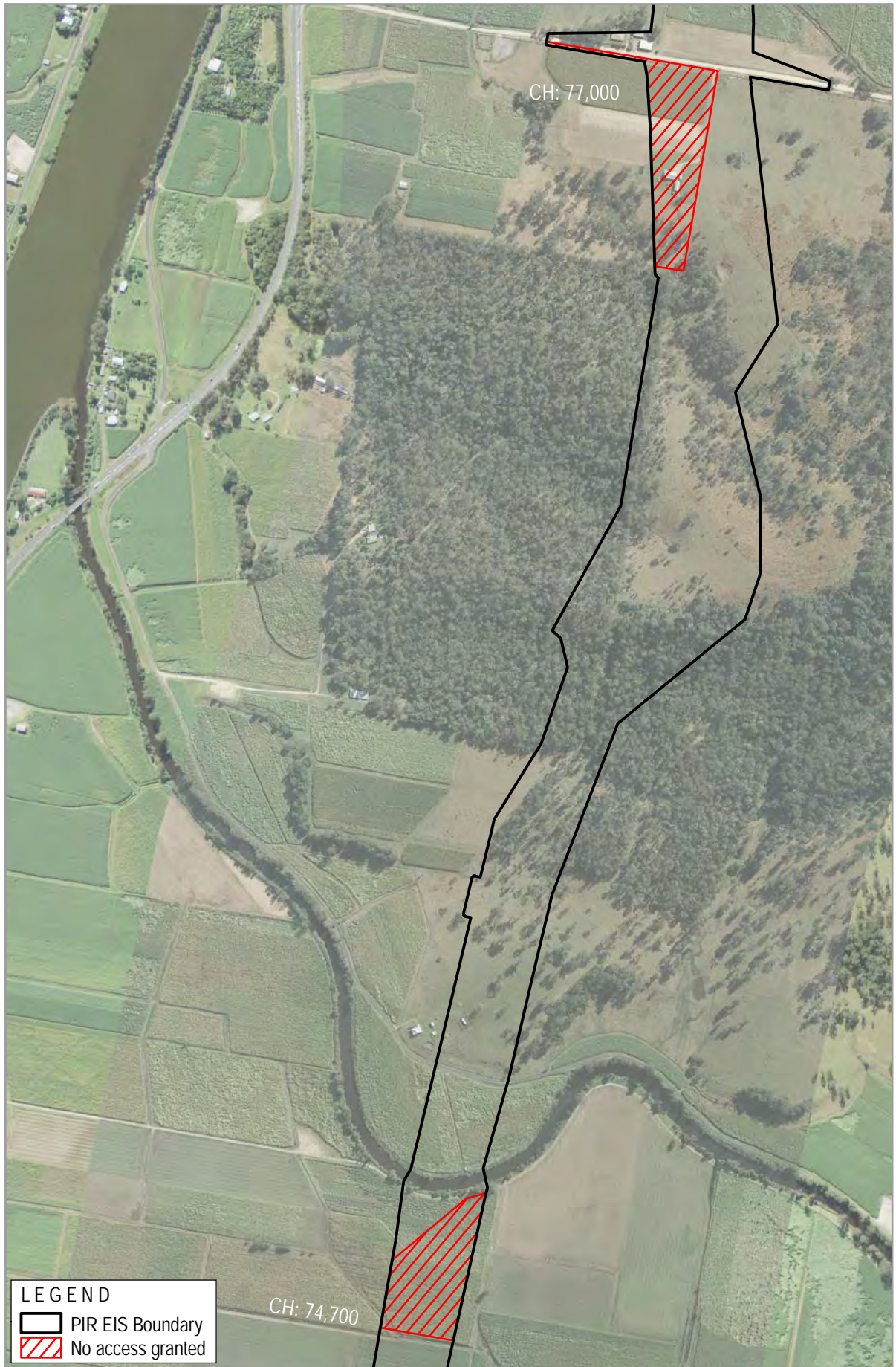
Determining the types of nest boxes required involved conducting a literature review of appropriate nest box design requirements as well as an assessment of potential fauna species likely to utilise HBTs in the locality.

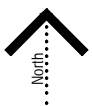
A review of the following information was undertaken to determine a list of hollow-obligated fauna occurring/ potentially occurring within the project site:

- EIS for the W2B Project (SKM 2013).
- Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife.
- Opportunistic fauna sightings during field surveys.

Nest box types were prescribed on a proportional basis to offset the loss of particular hollow resources. Consideration was also given to minimising competitive interactions for nesting/ denning resources.







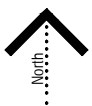
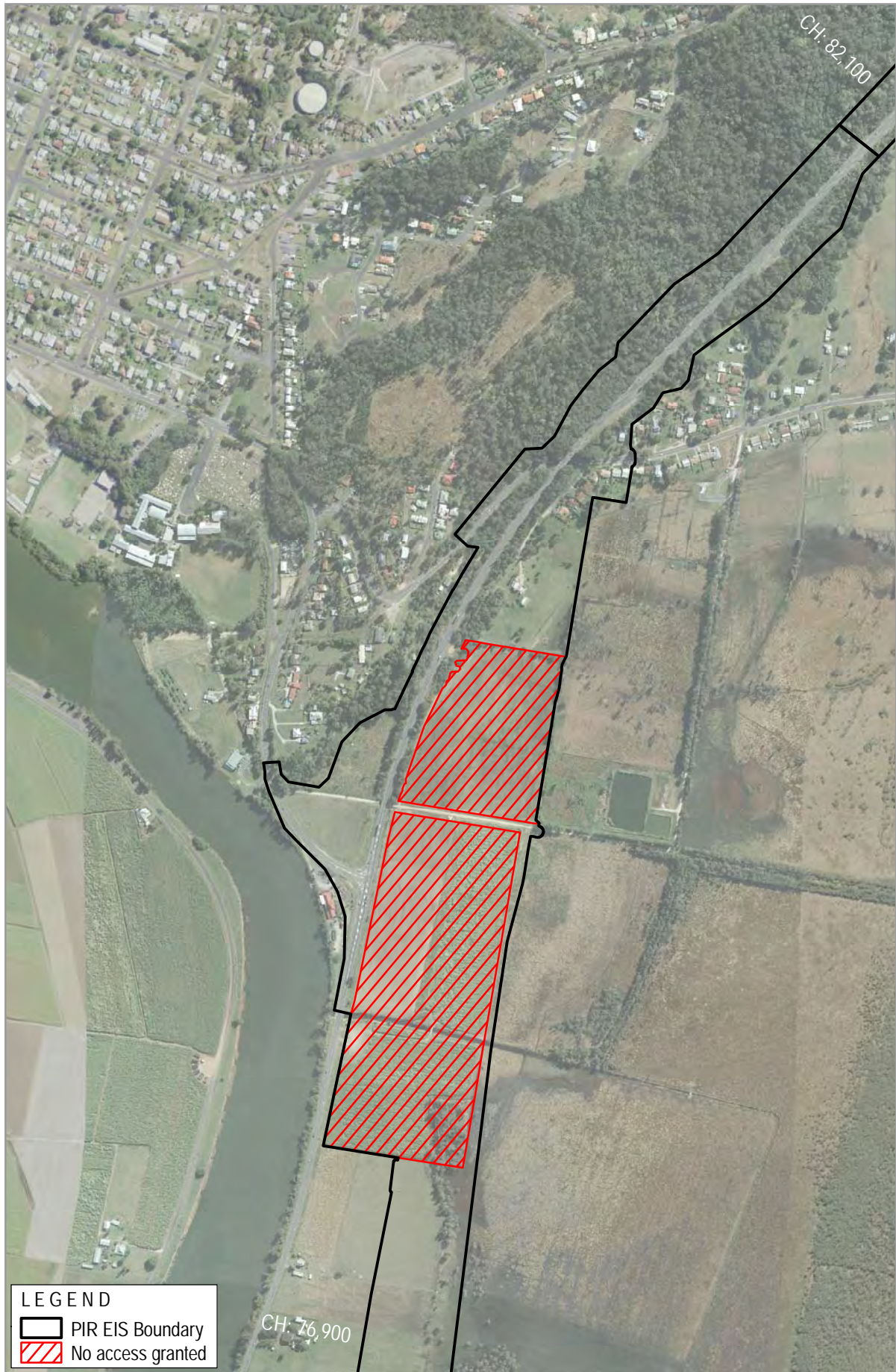
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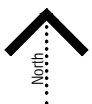
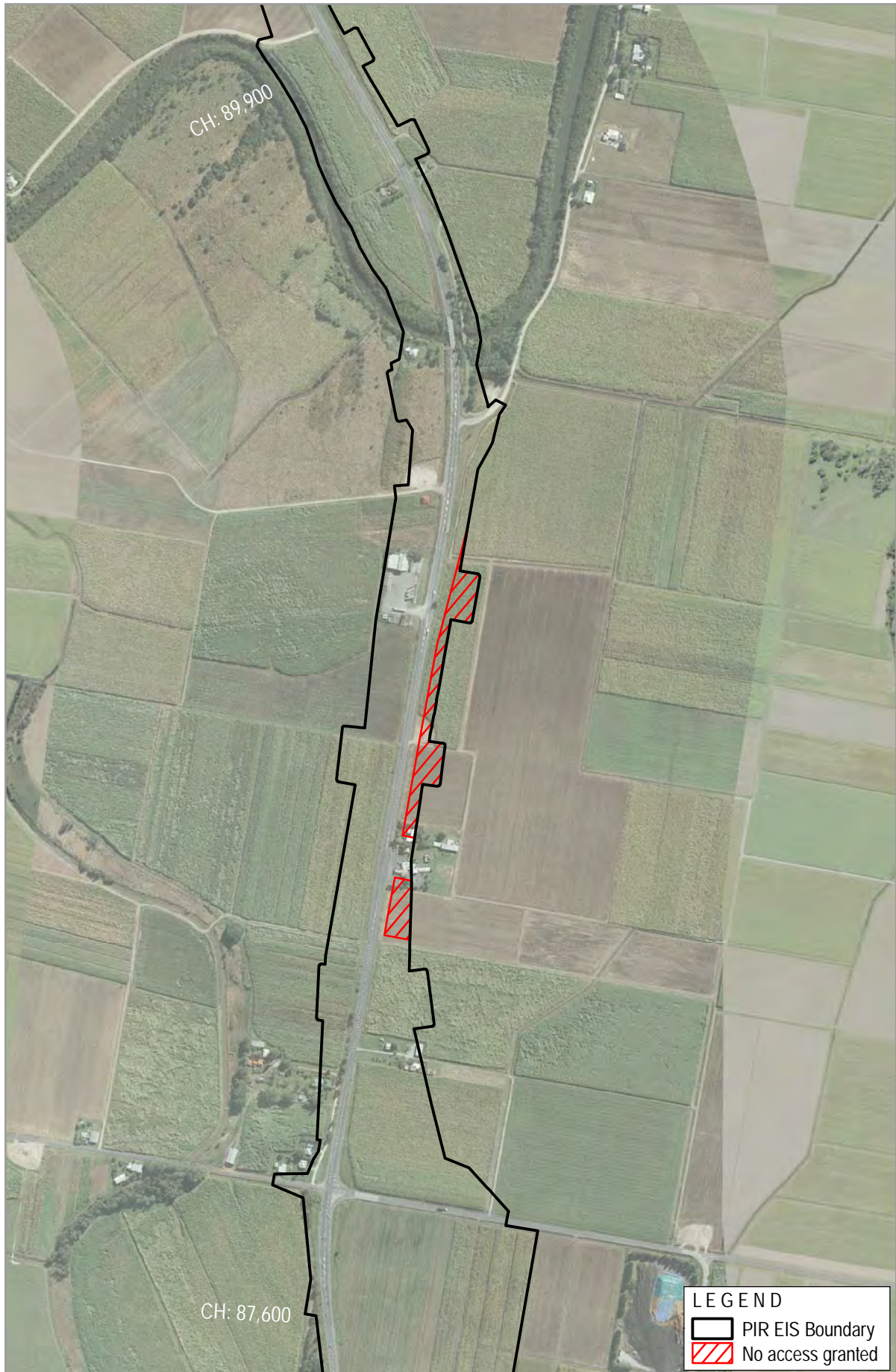
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Areas of the Project Site Not Accessed (Map 3)

W2B Sections 4 and 5 Nestbox Management Plan
2321-1072

Illustration 2.3





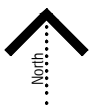
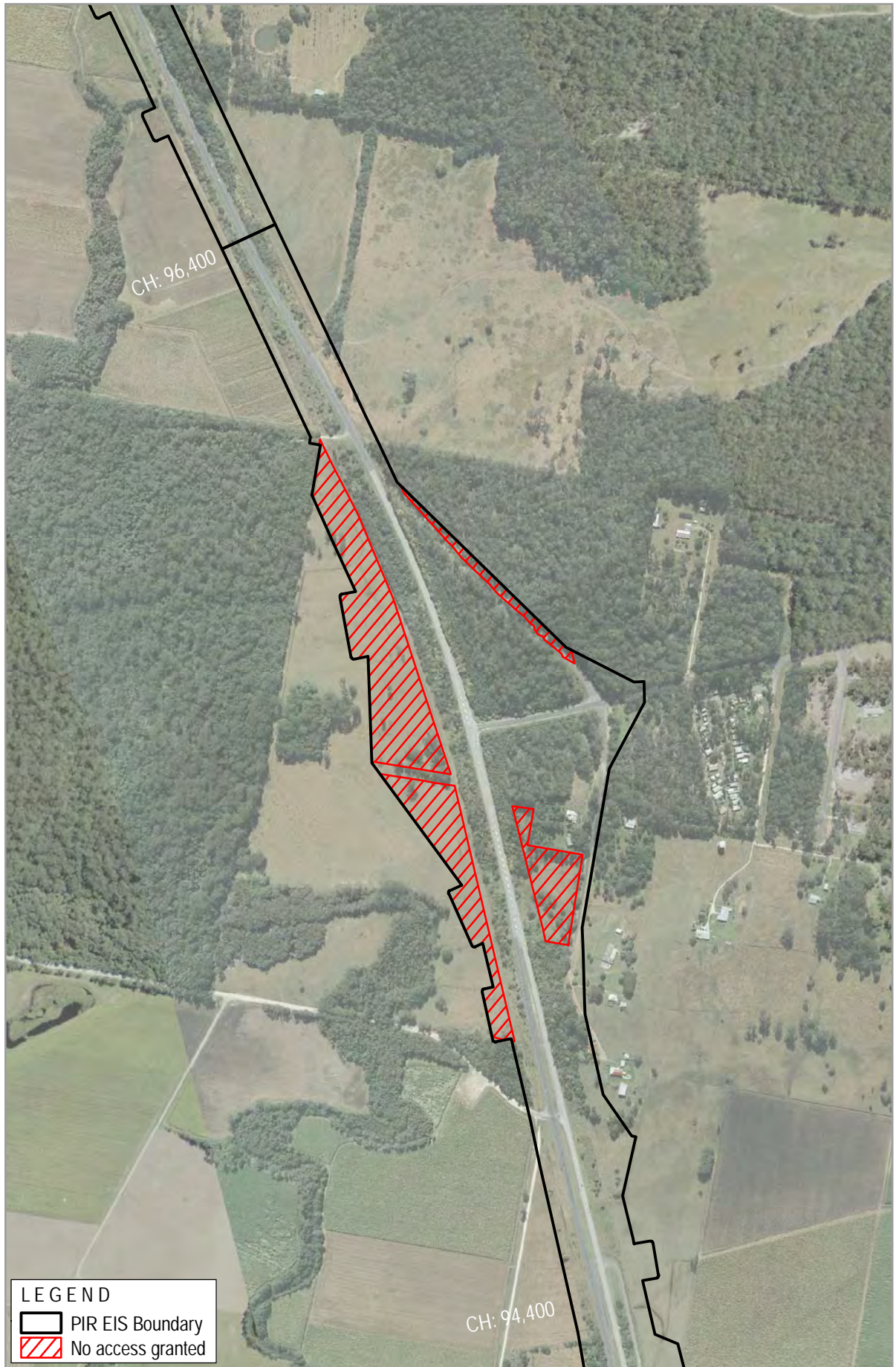
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Areas of the Project Site Not Accessed (Map 5)

W2B Sections 4 and 5 Nestbox Management Plan
2321-1074

Illustration 2.5



Areas of the Project Site Not Accessed (Map 6)

Results

3.1 Location of HBTs

A variety of hollow-bearing trees (HBTs) were recorded within the project boundary (and 10 metre buffer zone) primarily within forested areas. In total 141 HBTs containing a total of 302 functional hollows were recorded and are shown in **Illustrations 3.1 to 3.12**. Based on indicative clearing limits provided by RMS, it is estimated that approximately 89 HBTs would be cleared as part of the project.

A number of areas having a high density of HBTs (i.e. >1/ ha) were identified within the project site and are shown in **Table 3.1**.

Table 3.1 Areas of High Density HBTs

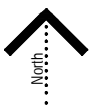
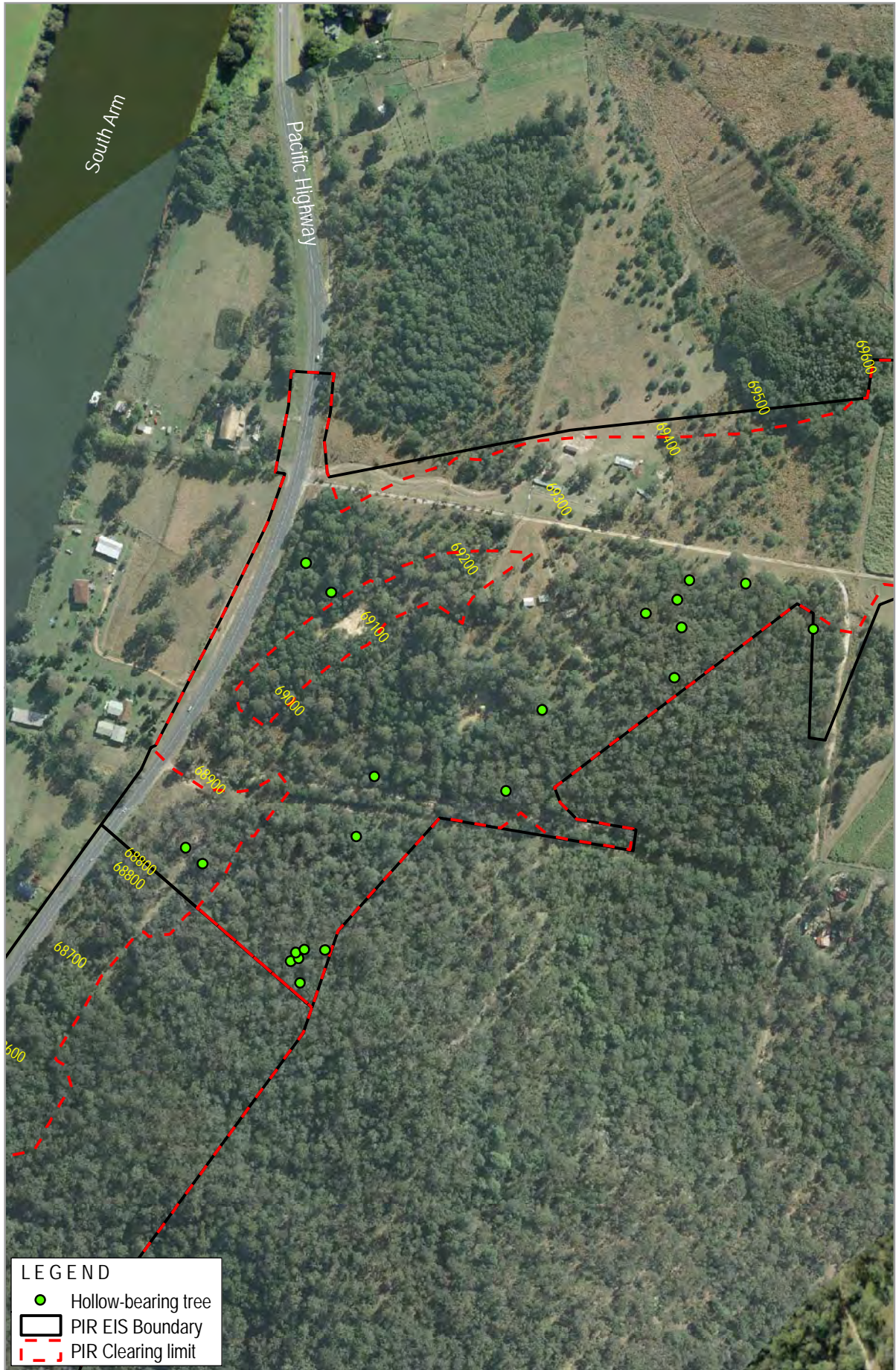
<i>Area Number</i>	<i>Chainages</i>	<i>Vegetation Community</i>	<i>Number of HBTs</i>
1	68,800-69,500	<ul style="list-style-type: none"> ▪ Forest Red Gum Swamp Box of the Clarence valley lowlands 	24
2	75,500-76,900	<ul style="list-style-type: none"> ▪ Grey Gum-Grey Ironbark open forest of the Clarence lowlands ▪ Spotted Gum-Grey Ironbark-Pink Bloodwood open forest of the Clarence lowlands 	77
3	79,300-80,050	<ul style="list-style-type: none"> ▪ Paperbark swamp forest of the coastal lowlands 	16
4	89,400-89,600	<ul style="list-style-type: none"> ▪ Grey Mangrove low closed forest 	20
5	95,300-95,800	<ul style="list-style-type: none"> ▪ Grey Gum-Grey Ironbark open forest of the Clarence lowlands 	Unknown due to access restrictions but assumed to be >20

3.2 Characteristics of HBTs

A summary of the characteristics of tree hollows recorded within the project site is provided below in **Table 3.2** with full details of HBTs included in **Appendix B**. In total 158 (52%) hollows were limb hollows and 144 (48%) hollows were trunk hollows. Most HBTs contained more than one hollow with an average of 2.1 hollows within each HBT. This number is considered to be relatively low reflecting the previous timber harvesting undertaken within the locality and reduced number of old growth trees within the project site.

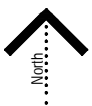
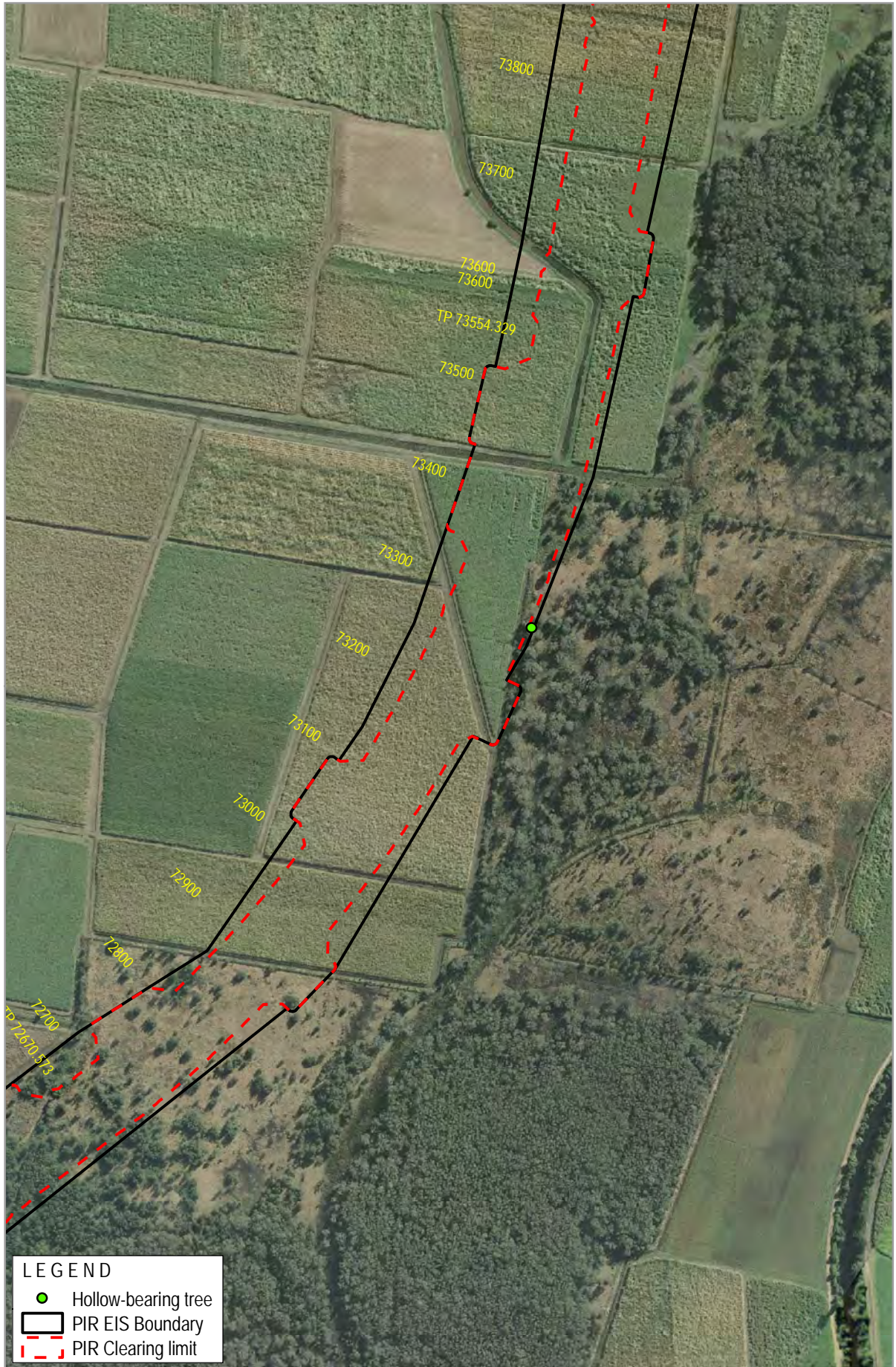
Table 3.2 Summary of HBT Characteristics

<i>Type of Hollows</i>	<i>Number of Hollows</i>		
	<i>Small (=<50mm)</i>	<i>Medium (50-100mm)</i>	<i>Large (>150mm)</i>
Limb Hollows	44 (15%)	66 (21%)	48 (16%)
Trunk Hollows	44 (15%)	63 (21%)	37 (12%)
Total	88 (30%)	129 (42%)	85 (28%)



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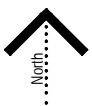
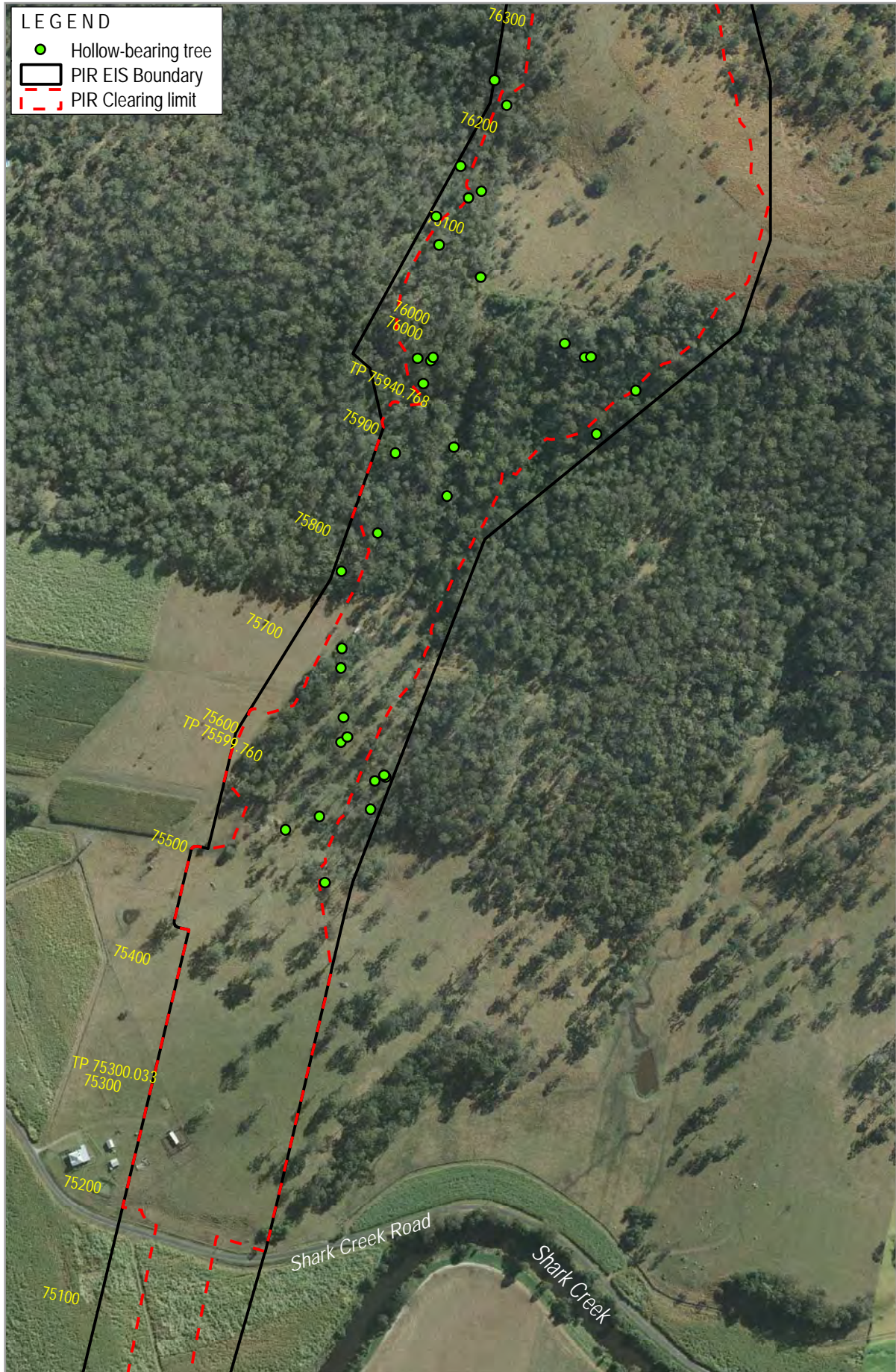


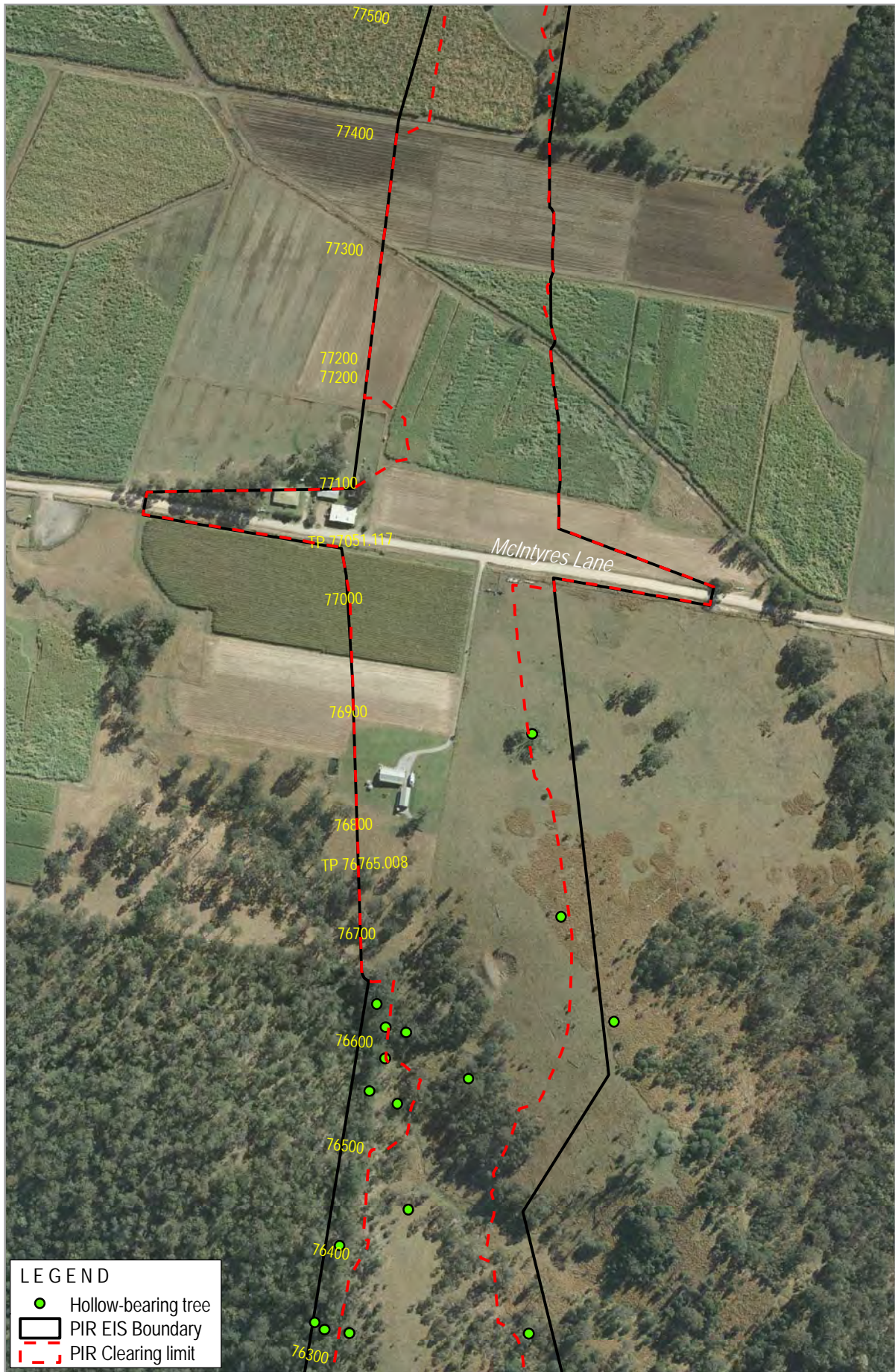


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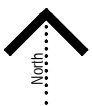
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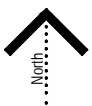




LEGEND

- Hollow-bearing tree
- PIR EIS Boundary
- PIR Clearing limit





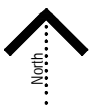
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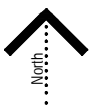
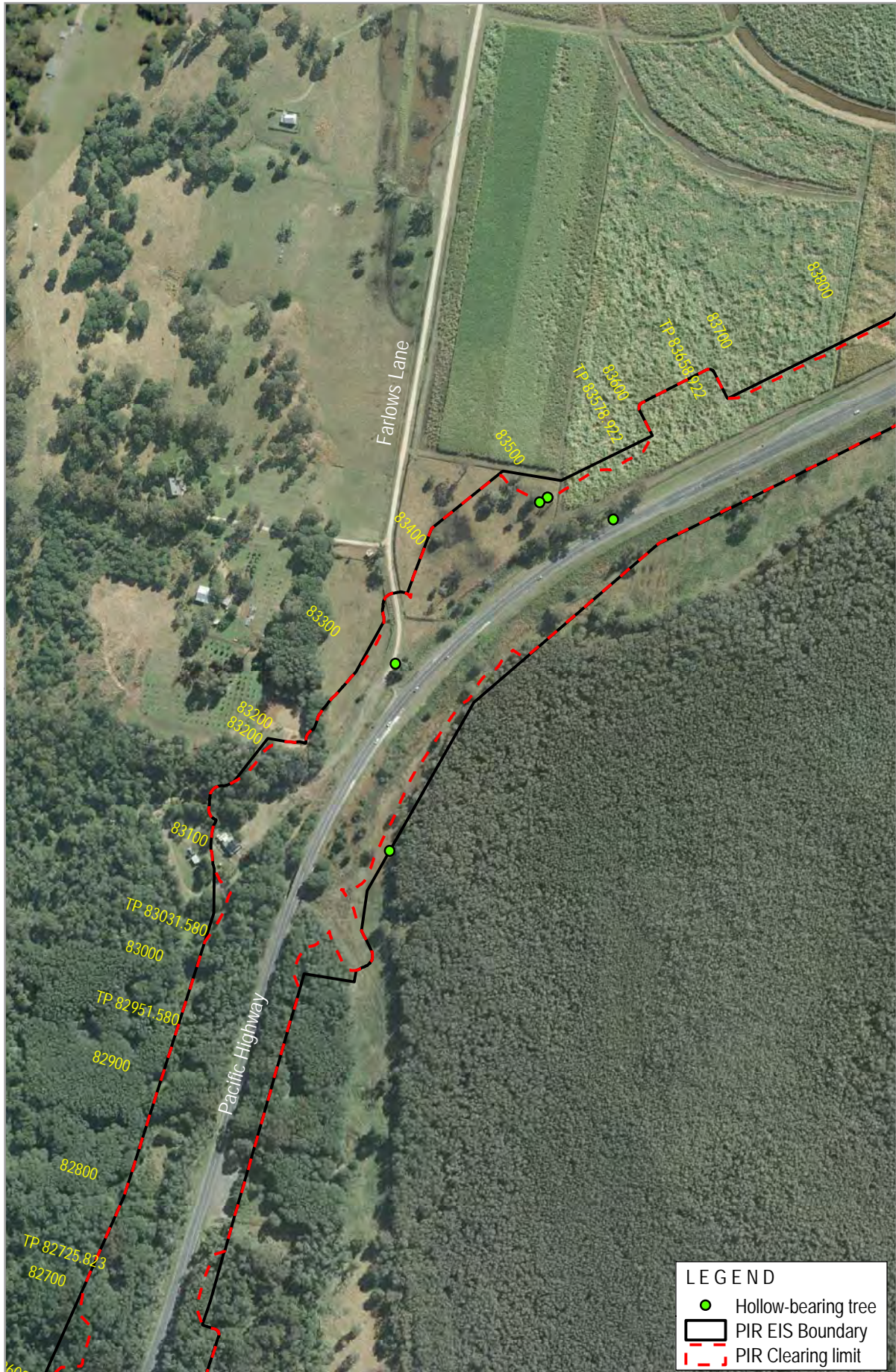
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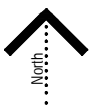
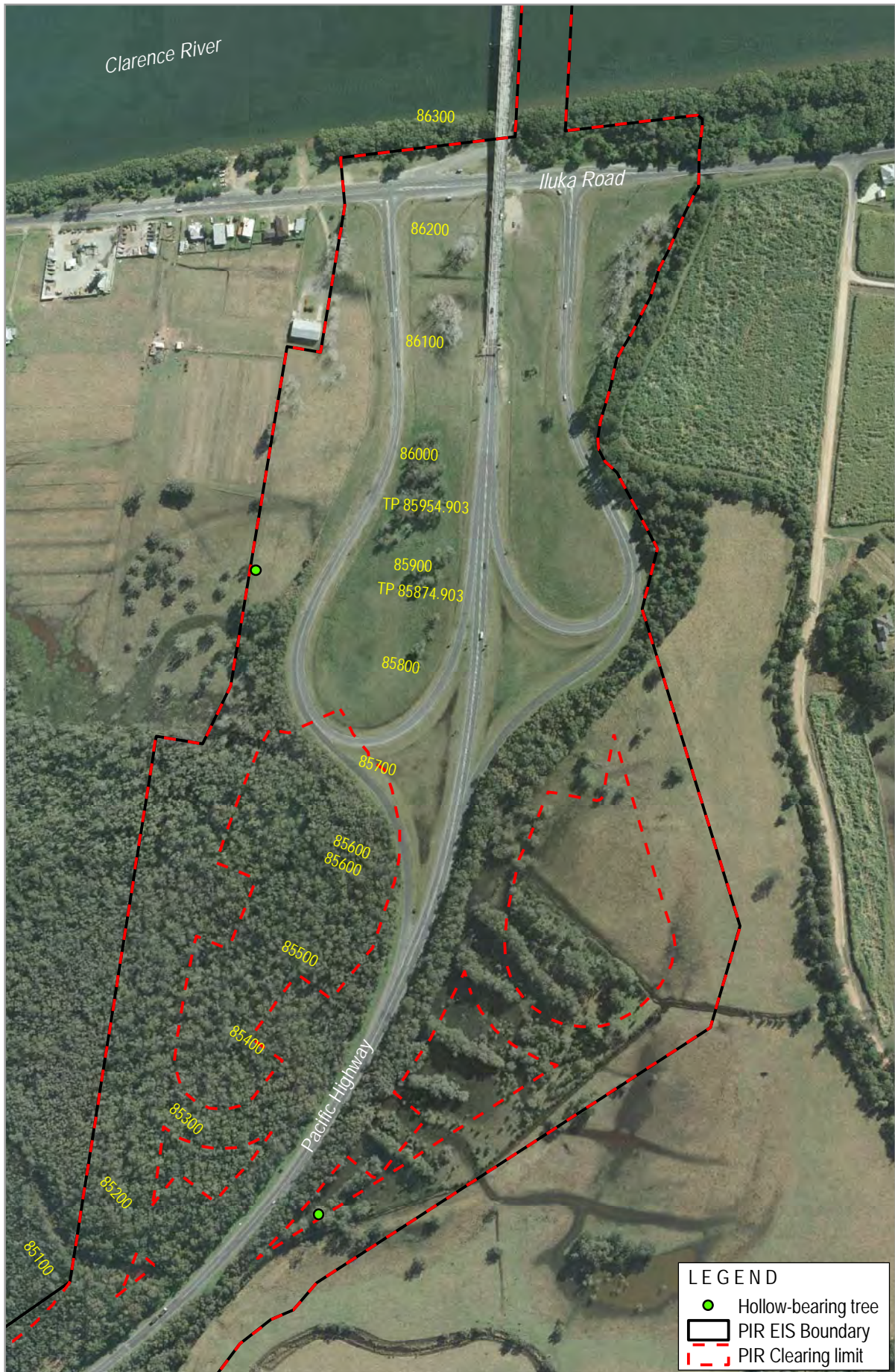
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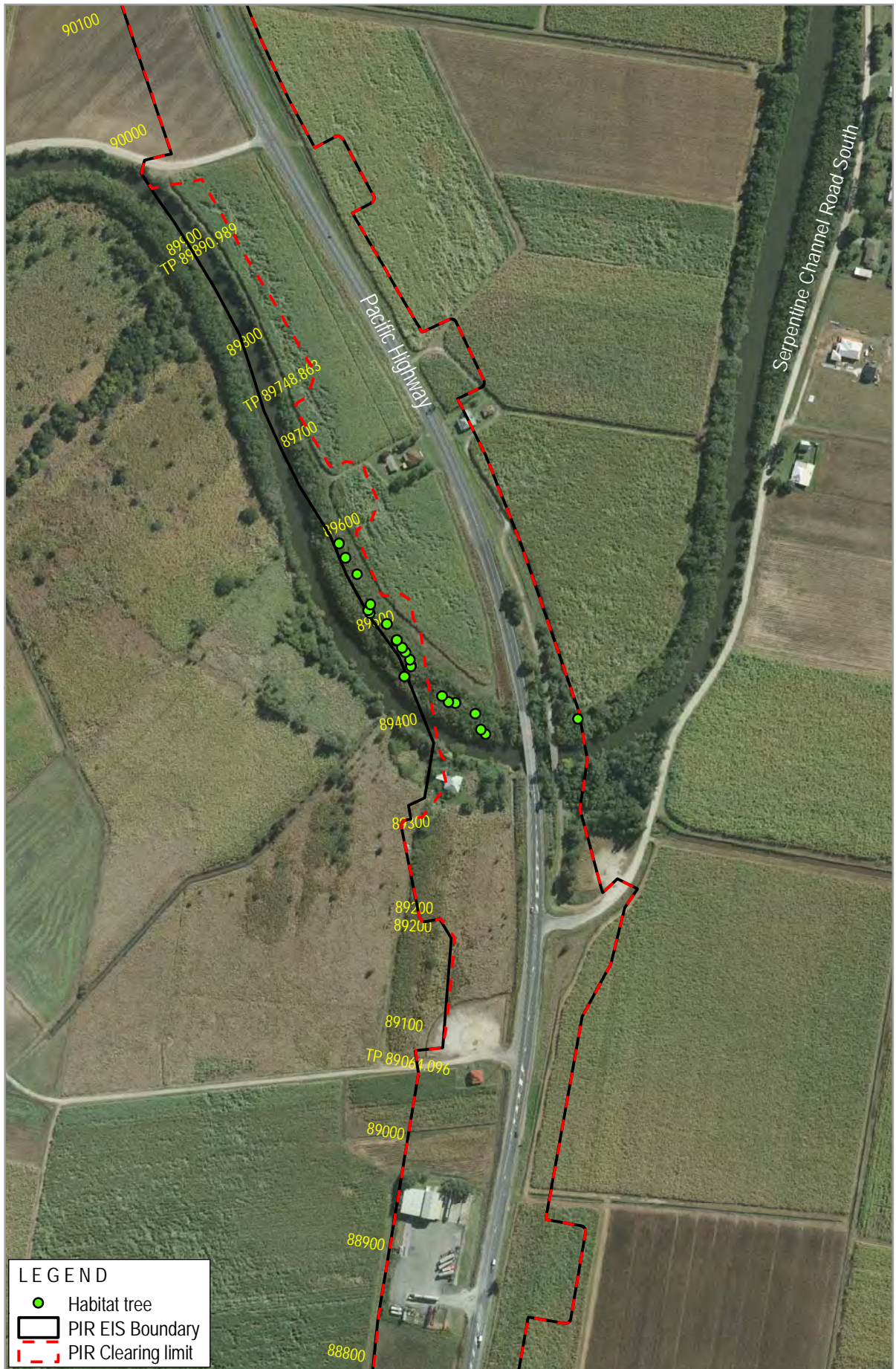
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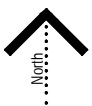
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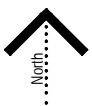
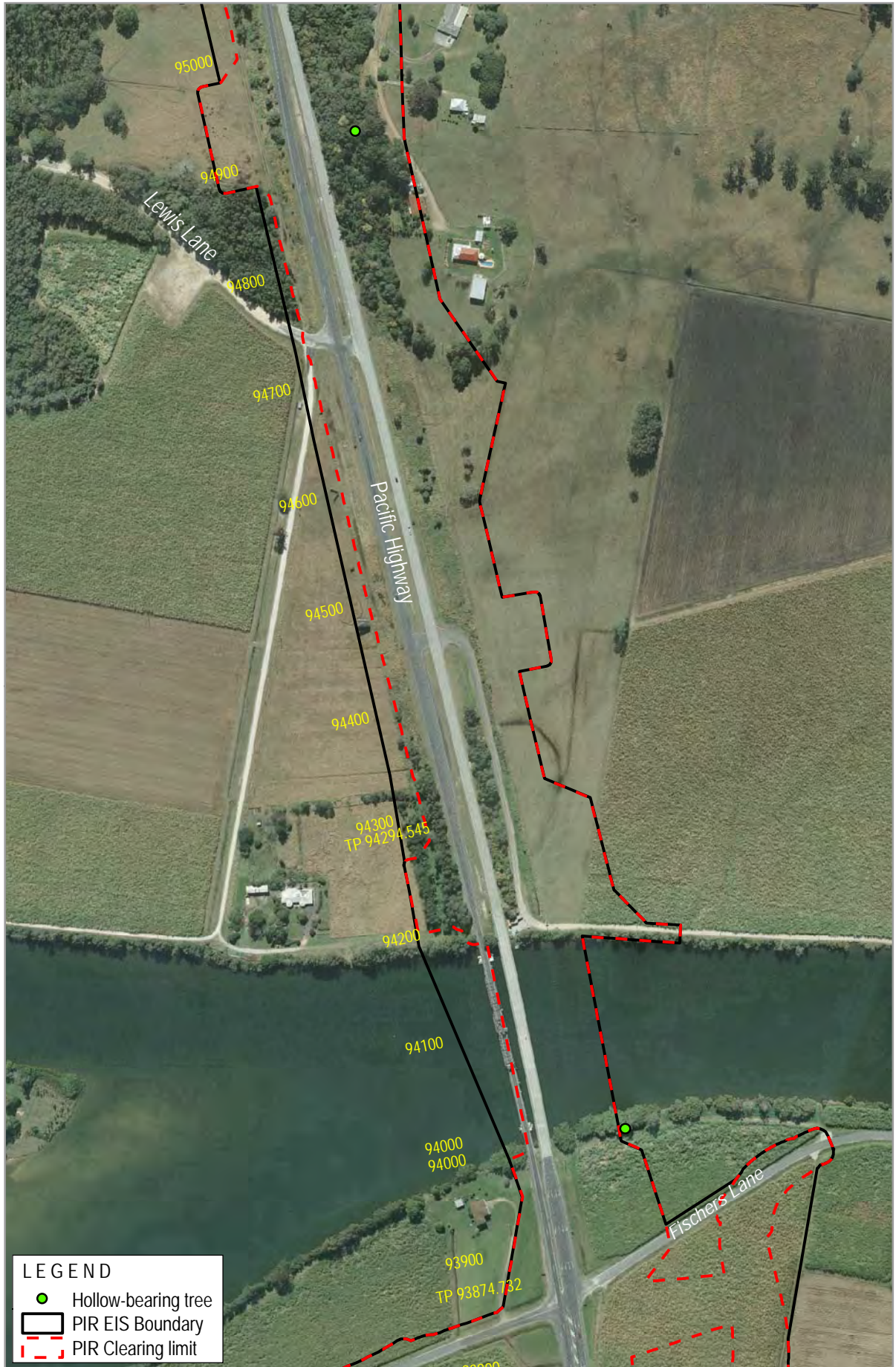
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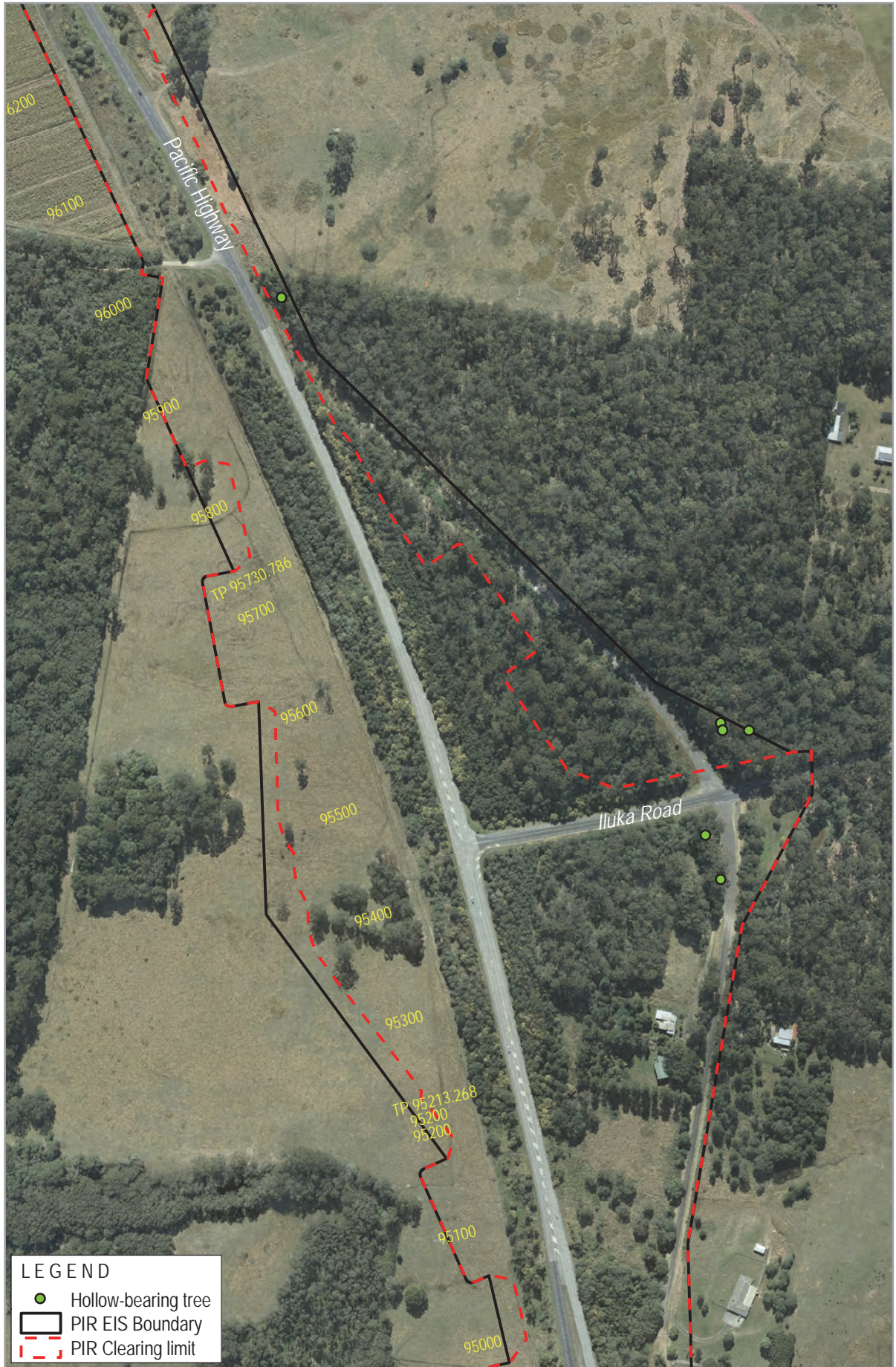
- Habitat tree
- PIR EIS Boundary
- PIR Clearing limit





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LEGEND

- Hollow-bearing tree
- PIR EIS Boundary
- PIR Clearing limit



3.3 Fauna Usage of Hollow-bearing Trees

Habitats associated with Sections 4 and 5 ranges from cleared pasture and agricultural land (mostly sugar cane) representing low quality fauna habitat to areas of dry and moist sclerophyll forest and floodplain vegetation communities representing moderate to high quality habitat. HBTs within the project site and surrounds would provide a range of denning, nesting and overwintering opportunities for a number of fauna species. Based on opportunistic fauna observations and a desktop review, 54 fauna species were considered to be species likely to utilise HBTs in the locality (refer to **Appendix C**). These species include:

- Twenty-six bird species.
- Twenty-two mammal species.
- Four frog species.
- Two reptile species.

Approximately 12 threatened fauna species are considered to have potential to utilise hollows occurring within the subject site (refer to **Appendix C**). Of these the Brush-tailed Phascogale has been confirmed within dry sclerophyll forest to the south of Section 4. Forested areas throughout the site are also considered probable habitat for threatened glider species, large forest owls, microbats and woodland birds.

Fauna species with potential to utilise HBTs can generally be classified into the following groups based on the characteristics of hollows which they would utilise:

- Scansorial Fauna (e.g. *Antechinus* sp and Brush-tailed Phascogale).
- Small Gliders (e.g. Sugar Glider [*Petaurus breviceps*]).
- Large Gliders (e.g. Yellow-bellied Glider).
- Possums (e.g. Brush-tailed Possum [*Trichosurus vulpeculari*]).
- Microbats (e.g. Large-footed Myotis [*Myotis macropus*]).
- Medium Sized Parrots/ Lorikeets (Rainbow Lorikeet [*Trichoglossus haematodus*]).
- Cockatoos (e.g. Sulphur-crested Cockatoo [*Cacatua galerita*]).
- Small Owls (e.g. Tawny Frogmouth [*Podargus strigoides*]).
- Large Forest Owls (e.g. Masked Owl).

Nest Box Management Strategy

4.1 Replacement Nest Box Zones

HBT data primarily indicated five areas within the project boundary where HBTs are to be cleared. It is considered appropriate that nest box replacement zones be focused on each of these areas. Other areas where HBTs were located comprised isolated paddock trees with some hollows in mostly cleared areas representing generally low quality fauna habitat. Replacement nest box zones are shown in **Illustrations 4.1 to 4.5**. Some zones have been divided into a number of smaller areas to provide a spread of nest boxes along or either side of the alignment. Nest boxes will be installed in appropriate trees within each zone as prescribed in the sections below.

The lack of State Forests, National Parks and Flora Reserves associated with Sections 4 and 5 of the W2B project poses challenges in ensuring land tenure challenges for replacement nest box zones. Where possible these zones have been located within RMS owned land (outside the clearing limits). A number of land owners in the vicinity of Tyndale and Greens Hill were approached to include parts of private property as part of nest box replacement zones. Permission was obtained to utilise private land in the Greens Hill area and parts of nest box replacement zone 2 have been configured to incorporate this land.

As mentioned, Area 5 (located in proximity to Iluka Road) was unable to be completely surveyed due to property access restrictions. Based on the vegetation type and likelihood of relatively high densities of HBTs occurring within this area, a replacement nest box zone is proposed associated with this area. Additional field work will be required in this area to collect HBT data to allow an accurate assessment of required nest box numbers/ types.

4.2 Nest Box Types and Design Specifications

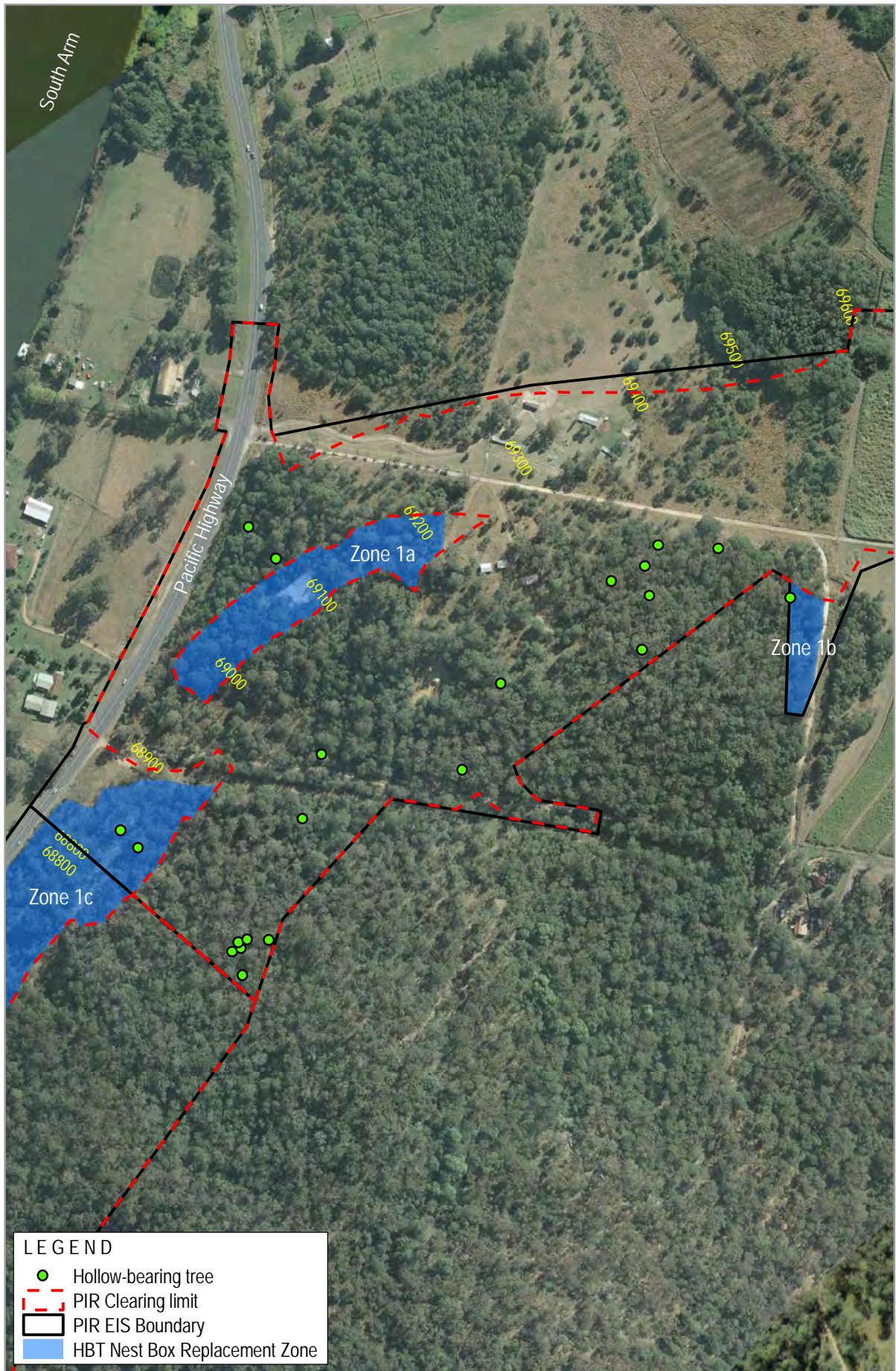
In order to remain consistent with recent Pacific Highway nest box management plans the following nest box types are proposed:

- Scansorial Fauna.
- Small Gliders.
- Large Gliders.
- Possums.
- Microchiropteran Bats.
- Medium sized Parrots and Lorikeets.
- Cockatoo.
- Small Owls.
- Large Forest Owls.

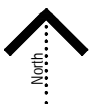
Based on a literature review, design specifications for nest boxes to be used have been determined and are detailed in **Table 4.1**.

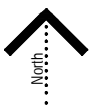
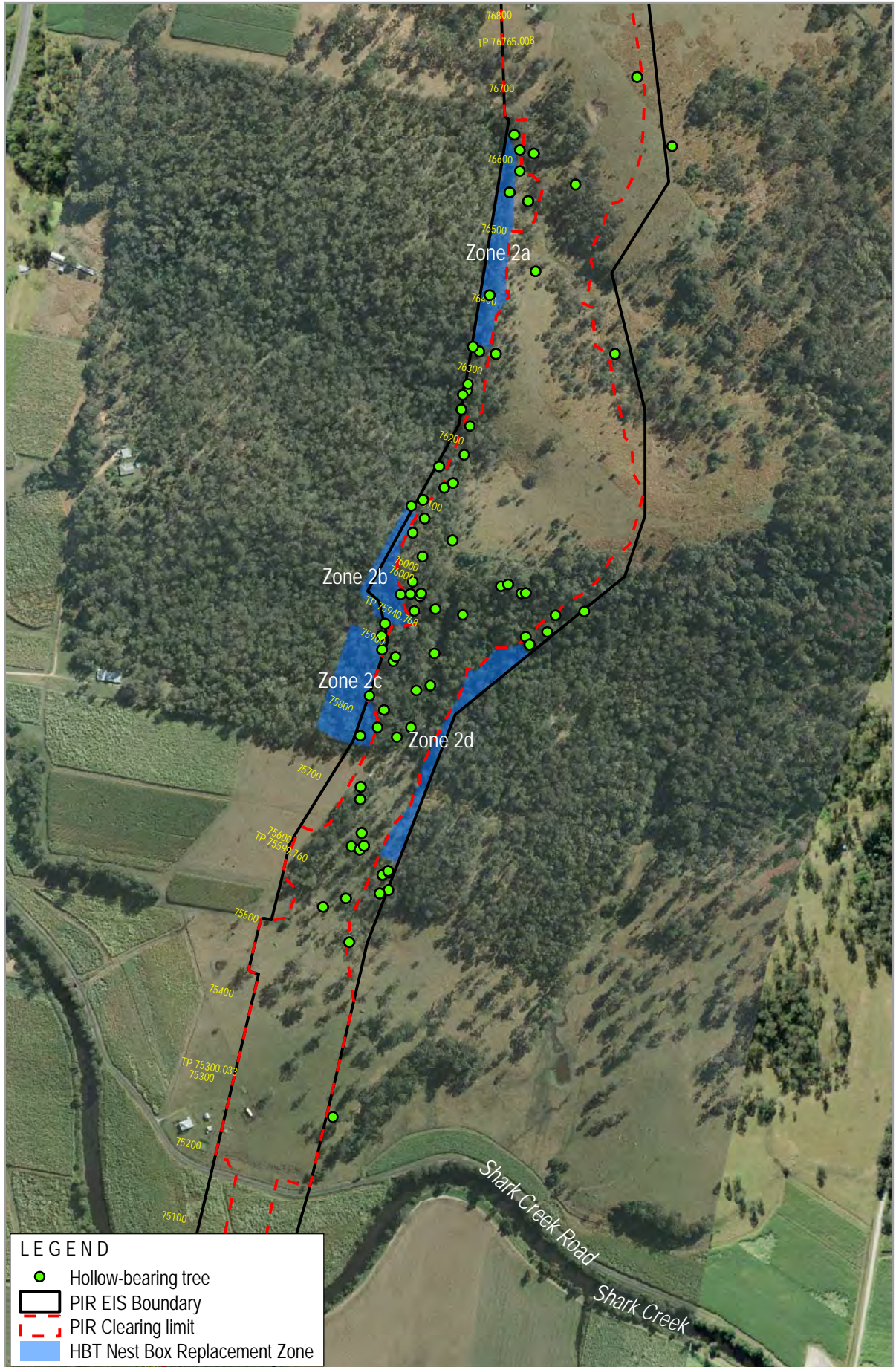
Table 4.1 Nest Box Specifications

<i>Nest Box Type</i>	<i>Fauna Group</i>	<i>Nest Box Dimensions (Lewis 2013, Franks and Franks 2006)</i>				<i>Comments</i>
		<i>Inner Width/ Height (mm)</i>	<i>Depth (mm)</i>	<i>Entrance Width (mm)</i>	<i>Height Above Ground (m)</i>	
1	Scansorial Fauna	180 x 180	300	35-40	3-6	-
2	Small Gliders	150 x 250	300	40-45	3-6	Position entrance to face tree
3	Large Gliders	250 x 300	400	70-90	6-8	Position entrance to face tree
4	Possums	250 x 300	400	85-100	5-8	-
5	Microbats	200 x 200	400	20-30	3-5	-
6	Medium sized Parrots/ Lorikeets	200 x 200	400	65	5-8	2-5 boxes/ colony
7	Cockatoos	300 x 400	1200	200	8-10	Nest box should be reinforced with PVC around the entrance to prevent being chewed
8	Small Owls	250 x 300	500	100	8-10	-
9	Large Forest Owls	400 x 400	800	200	12-20	Short horizontal spout entrance



Location of Replacement Nestbox Zones (Zone 1)





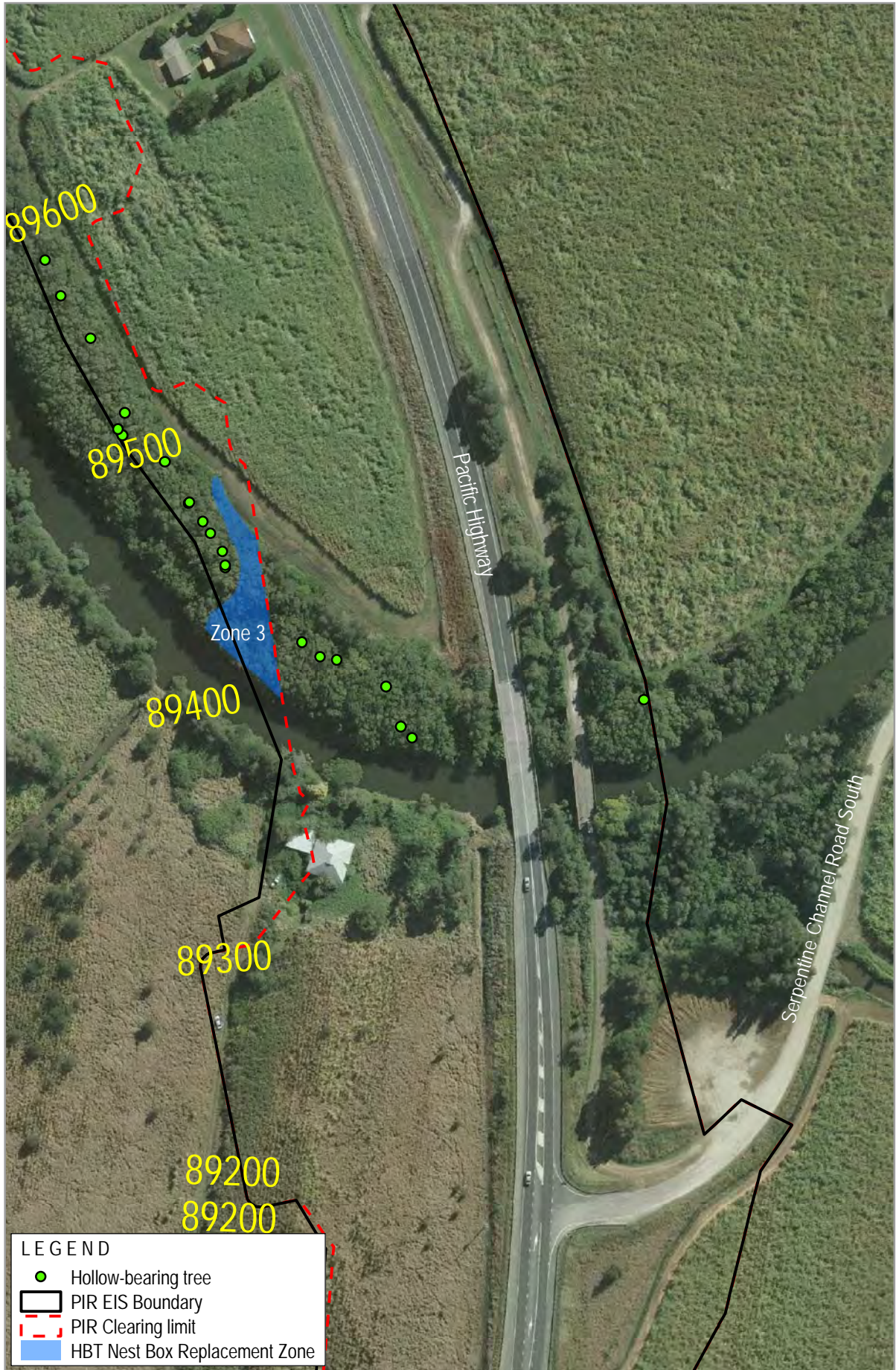
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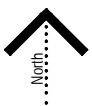
Location of Replacement Nestbox Zones (Zone 2)

W2B Sections 4 and 5 Nest Box Management Plan
2321-1055

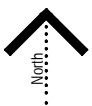
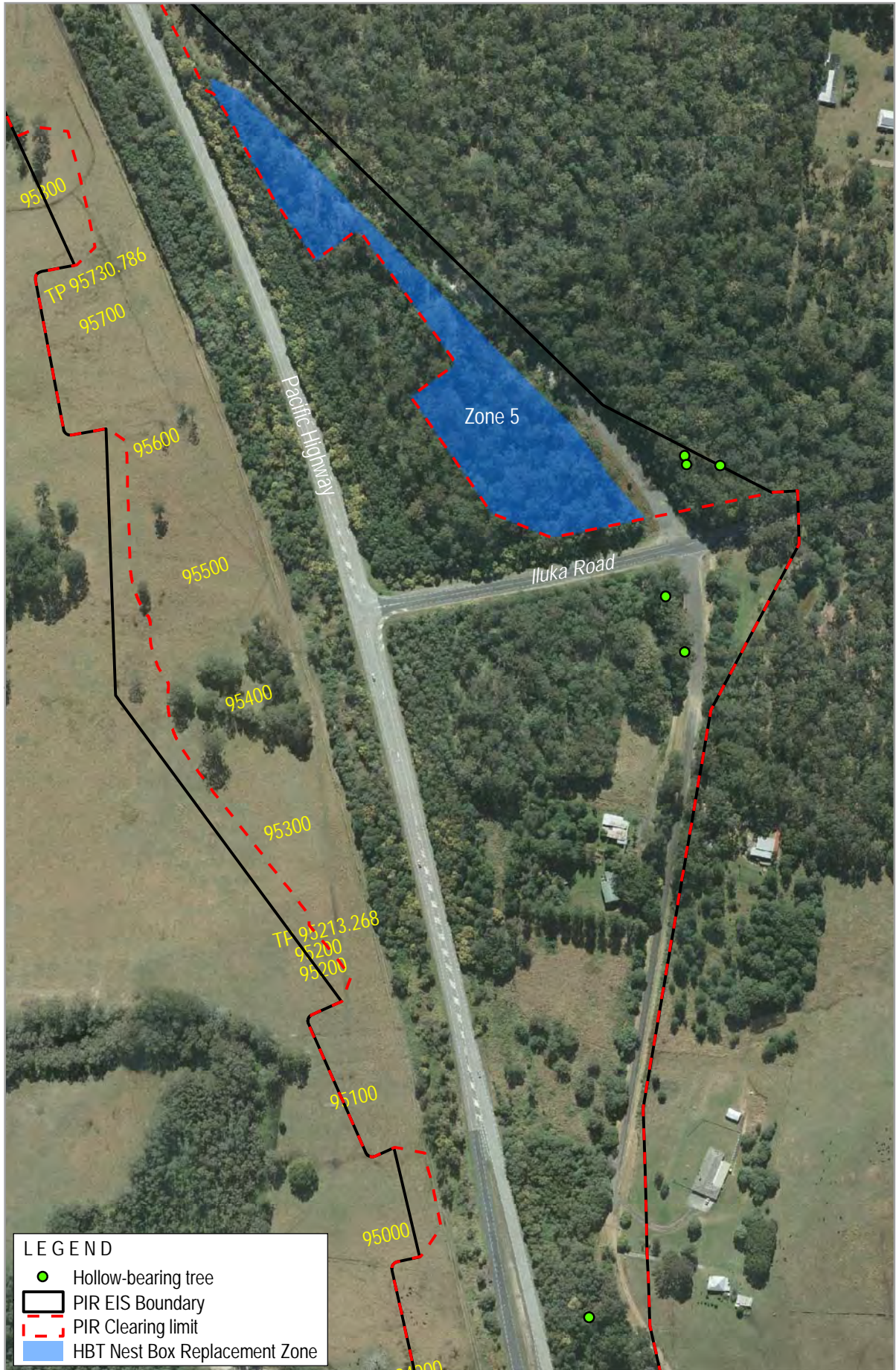
Illustration 4.2



Location of Replacement Nestbox Zones (Zone 3)



Location of Replacement Nest Box Zones (Zone 4)



4.3 Nest Box Numbers

Nest box numbers were initially calculated using the methodology detailed in Section 2. However the derived numbers of nest boxes required were well below or above the general recommendation of 1:1 (hollows removed: nest boxes erected). The most likely explanations for this equation not being appropriate for Sections 4 and 5 of the W2B project are; HBT's were located in isolated pockets of remnant vegetation, some nest box zones were small in size with high numbers of hollows and the number of functional hollows detected per tree appears to be much less than that reported for mature forest areas such as that occurring on the Warrell Creek to Urunga project (Lewis, 2013). Due to these factors it was considered more appropriate to initially propose a 1:1 ratio of nest boxes to be provided for each functional hollow to be cleared. In some cases the ratio of 1:1 has been reduced slightly to avoid an oversupply of nest boxes.

The data collected from reference sites has been used to provide context on the type and availability of hollow resources within to be provided within nest box replacement zones.

The assessment of nest box numbers is shown in Table 4.2 with a break down of nest box numbers and types required provided in Table 4.3.

Table 4.2 Assessment of Nest Box Numbers Required

<i>Zone Number</i>	<i>Number of Hollow-bearing Trees to be Removed</i>	<i>Number of Functional Hollows to be Removed</i>	<i>Area of Vegetation to be Removed (ha)</i>	<i>Number of Nest Boxes Required (Determined by Lewis formula)</i>	<i>Adjusted Number of Nest Boxes Required</i>
1	18	38	12.6	4	36
1a					
1b					
1c					
2	40	84	12.9	8	50
2a					
2b					
2c					
2d					
3	7	15	0.4	44	6
4	2	4	0.4	12	3
5	-	-	-	-	35 (estimated)

* Nest box data for Zone 5 is not currently known as this area was unable to be accessed due to landowner restrictions. Numbers provided are estimates only.

Table 4.3 Nest Box Numbers/ Types Required

Nest Box Type	Number of Nest Boxes Required				
	Zone 1	Zone 2	Zone 3	Zone 4	*Zone 5
Scansorial Fauna	6	7		1	6
Small Gliders	6	7			6
Large Gliders	3	7			4
Possums	3	7	2		4
Microbats	3	6	2		3
Medium sized Parrots/ Lorikeets	6	9	2	2	6
Cockatoos	3	3			2
Small Owls	3	2			2
Large Forest Owls	3	2			2
Total Number Required	36	50	6	3	35

* Nest box numbers for Zone 5 are not known as this area was unable to be accessed due to landholder restrictions. Numbers provided are an estimate only.

4.4 Nest Box Installation

4.4.1 Ecologist Supervision

The project manager and/ or environment manager is to engage a suitably qualified ecologist to supervise the installation of nest boxes in accordance with this plan. The ecologist would decide on the precise host trees within nest box zones taking into account information within this plan as well as the following factors:

- Positioning microbat boxes near potential flyways.
- Selecting mainly larger trees (both in D.B.H and canopy cover) for host trees where possible.
- Selecting longer lived tree species (e.g. Eucalypt/ Corymbia/ Angophora species for host trees).
- Consideration of location of habitat connectivity structures (i.e. glider crossing structures associated with replacement zones 2b, 2c and 2d), existing hollows and food resources in relation to nest box location.

4.4.2 Timing

At least 70% of nest boxes must be installed prior to the removal of any vegetation. The remainder should be installed within three months post completion of clearing once the exact number of HBTs removed as part of Sections 4 and 5 are known.

4.4.3 Attaching Nest Boxes to Trees

The recommended attachment method for nest boxes is the Habisure system (refer to **Illustration 4.6**) which allows for at least one metre growth in the diameter of the host tree before adjustment is required. Bolting or screwing nest boxes to trees is not recommended due to increased damage to trees and a comparatively short lifespan.

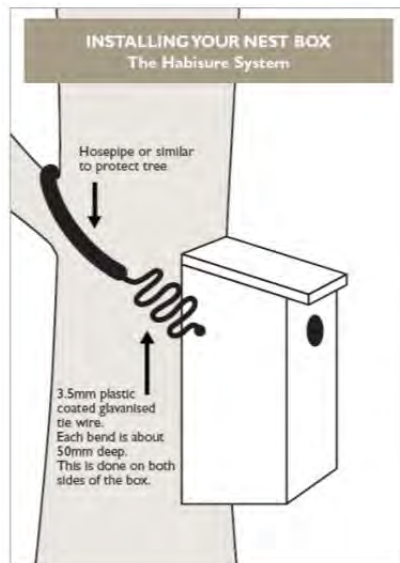


Illustration 4.6 The Habisure System of Nest Box Attachment (Franks and Franks, 2006)

4.4.4 Height

The recommended heights for nest box installation are provided in Table 4.1.

4.4.5 Aspect

Nest boxes should generally be orientated between northwest and east to avoid hot afternoon sun and the dominant direction of severe storms. Exceptions to this rule may be considered for microbat boxes which may benefit from direct late afternoon sun during overwintering periods. Additionally, Glider boxes which have entrances facing the tree would not have issues with aspect. Nest boxes should be placed to avoid other artificial light forms (i.e. street lights).

In order to facilitate monitoring of nest boxes all nest boxes should be assigned a unique identification code referencing the nest box zone and number. Aluminium identification tags with the nest box code are to be placed at eye level on the recipient tree. At the time of installation the ecologist is to record the following information:

- Identification number.
- Nest box type.
- GPS location.
- Tree species.
- DBH of host tree.
- Nest box height.
- Orientation.

4.5 Monitoring and Maintenance

A monitoring and maintenance program is proposed to evaluate the effectiveness of the nest box strategy and allow for routine repairs of nest boxes during the project.

4.5.1 Monitoring Program

Monitoring of nest boxes is to be undertaken by a qualified ecologist in accordance with the timeframes outlined in Section 4.5.2. Nest boxes are to be accessed and checked using one of the following methods:

- Inspection camera on a pole.
- Elevated work platform.
- Ladders (in accordance with site safety rules).

The following information is to be recorded using a field pro-forma:

- Inspection dates and weather conditions at the time of inspection.
- Nest box number.
- Native species utilising the nest box: As a minimum, the species, number, sex and age of fauna utilising the nest box.
- Indications of usage (e.g. microbat guano or bird nesting material).
- Non-native species utilising the nest boxes.
- Signs of deterioration/ damage to the nest box.
- Required maintenance to be performed including exclusion of pest species.

4.5.2 Performance Indicators and Corrective Actions

The performance of the Nest Box program would be assessed against the following parameters as stated in the W2B Ecological Monitoring Program (SKM, 2013):

- Use of nest boxes by a wide range of fauna.
- Use of nest boxes designed for a target species being used by that species.
- Low rates of usage by exotic fauna.
- Reduced maintenance requirements.

Corrective actions to be implemented should the nest boxes be deemed ineffective are provided in Table 4.4.

Table 4.4 Nest Box Performance Monitoring and Corrective Action Plan

<i>Performance Indicator</i>	<i>Corrective Actions</i>	<i>Responsibility</i>
Nest box not being used by target species	Review the location, type and number of nest boxes used	RMS responsible for engaging suitably qualified ecologists to undertake the monitoring and suitably qualified contractors to undertake the maintenance
Poor uptake/ usage rate by native fauna		
Nest boxes become occupied by exotic or invasive fauna	Review/ change nest box design and/ or placement on tree to exclude undesirable species, treat if applicable or relocate those nest boxes to another location	
Nest boxes deteriorating rapidly and requiring maintenance	Identify causes of nest box failure, modify design and construct accordingly	

4.5.3 Maintenance

Maintenance inspections are to be undertaken in conjunction with monitoring events. Potential maintenance works would involve:

- Repairing nest boxes.
- Reattaching nest boxes to trees.
- Removal of pest species (including possible retrofitting of nest boxes to exclude pest species).
- Removal of excessive denning material (i.e. leaf litter).
- Replacement of fallen, damaged or degraded nest boxes.
- Repositioning or relocation of dysfunctional nest boxes.

If nest boxes need to be removed from the site for repair and shows signs of native fauna usage, alternative nest boxes should be installed in the same location upon removal of the damaged box.

4.5.4 Timeframes

Timeframes for nest box installation, monitoring and maintenance are provided in Table 4.5.

Table 4.5 Nest Box Management Timeframes

Task	Pre-construction	Construction			Post-construction					
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8		
Installation										
Nest box installation – pre-clearing 70% / post clearing 30%	✓									
Review of final nest box requirements following post clearing survey	✓									
Monitoring										
Spring monitoring			✓	✓		✓		✓		
Winter monitoring			✓	✓		✓		✓		
Maintenance										
*Maintenance inspections			✓	✓		✓		✓		
✓*Nest box maintenance			✓	✓		✓		✓		

* To be carried out in conjunction with monitoring events.



References

BushfireSafe Pty Ltd (2013). Weekly Summary Report-27 - 30 May 2013. Report prepared for Road and Maritime Services.

DEC (2004). Threatened Biodiversity Survey and Assessment: guidelines for developments and activities (working draft). NSW Department of Environment and Conservation, Hurstville, NSW.

Franks, A and Franks, S (2006). Nest Boxes for Wildlife: A Practical Guide. Blooming Books, Melbourne.

Lewis (2013). Warrell Creek to Urunga: Nest Box Plan of Management. Report prepared for the Roads and Maritime Services.

Roads and Maritime Services (2011). Biodiversity Guidelines: Protecting and Managing Biodiversity on RMS Projects.

SEWPAC (2011). Protected Matters Search Tool [Online]. Department of Sustainability, Environment, Water, Population and Communities: Available from:
<http://www.environment.gov.au/erin/ert/epbc/index.html>.

Sinclair Knight Merz, (2013). Environmental Impact Statement for the W2B Pacific Highway Upgrade Project.



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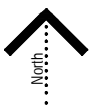
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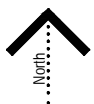


Appendix A

Hollow-bearing Tree Reference Sites



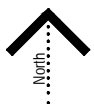
Location of Hollow-bearing Tree Reference Sites (Map 1)



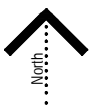
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Location of Hollow-bearing Tree Reference Sites (Map 2)



Location of Hollow-bearing Tree Reference Sites (Map 3)



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Location of Hollow-bearing Tree Reference Sites (Map 4)

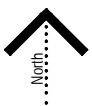
W2B Sections 4 and 5 Nest Box Management Plan
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Illustration 4

Information shown is for illustrative purposes only



Location of Hollow-bearing Tree Reference Sites (Map 5)



Location of Hollow-bearing Tree Reference Sites (Map 6)



Location of Hollow-bearing Tree Reference Sites (Map 7)



Appendix B

Hollow-bearing Tree Data

Table B.1 Hollow-bearing Tree Data

HBT ID.	Species	Co-ordinates (GDA 1994)		Approx. DBH (cm)	Dead/ Alive	Tree Height	Functional Hollows	Position and Size of Hollows					
		Easting	Northing					Trunk - Small (<5cm)	Trunk - Medium (5-15 cm)	Trunk - Large (> 15 cm)	Limb-Small (<5cm)	Limb - Medium (5-15 cm)	Limb-Large (<15cm)
3H1	Coast Banksia	515113	6731070	32	A	15	1		1				
3H2	Pink Bloodwood	515137	6731042	50	A	25	1		1				
3H3	Grey Ironbark	515337	6730931	59	A	20	2		2				
3H4	Grey Ironbark	515303	6730854	95	D	25	2	1	1				
3H5	Grey Ironbark	515435	6731022	79	A	22	1		1				
3H6	Stag	515469	6731009	45	D	14	2	2					
3H7	Forest Red Gum	515465	6731035	72	A	18	1	1					
3H8	Forest Red Gum	515476	6731054		A	10	3		3				
3H9	Forest Red Gum	515530	6731051	54	A	20	1		1				
3H10	Forest Oak	515590	6731005	37	A	15	1		1				
3H11	Pink Bloodwood	515594	6731007	45	A	22	1		1				
3H12	Grey Ironbark	515522	6730974	60	Dead section of tree	21	1		1				
3H13	Stag	515462	6730961	31	D	7	1		1		1		
3H14	Forest Red Gum	514999	6730801	61	A	22	1					1	1
3H15	Pink Bloodwood	515015	6730785	54	A	21	1		1				
3H16	Angophora sp	515161	6730811	57	A	20	1			1			
3H17	Angophora sp	515104	6730701	52	A	15	1	1					
3H18	Stag	515111	6730704	38	D	10	1			1			
3H19	Tindales Stringybark	515106	6730696		A	20	2				1	1	
3H20	Angophora sp	515098	6730693	43	A	15	1	1					
3H21	Stag	515107	6730672	46	D	8	1		1				
3H22	Grey Ironbark	515131	6730703	52	A	11	3			1	2		

HBT ID.	Species	Co-ordinates (GDA 1994)		Approx. DBH (cm)	Dead/ Alive	Tree Height	Functional Hollows	Position and Size of Hollows					
		Easting	Northing					Trunk - Small (<5cm)	Trunk - Medium (5-15 cm)	Trunk - Large (> 15 cm)	Limb-Small (<5cm)	Limb - Medium (5-15 cm)	Limb-Large (<15cm)
3H23	Stag	515175	6730748	34	D	9	4					1	3
3H24	Swamp Box	515178	6730868	81	A	16	1		1				
3H25	Broad-leaved Paperbark	518849	6732668	1.2	A	17	1		1				
3H26	Broad-leaved Paperbark	518847	6732645	92	A	18	1		1				
3H27	Forest Red Gum	519292	6734611	90	A	25	1					1	
3H28	Stag	519313	6734843	46	D	18	1	1					
3H29	White Mahogany	519366	6734913	60	A	15	2						2
3H30	White Mahogany	519354	6734909	65	A		1		1				
3H31	Whit Mahogany	519367	6734937	50	A	22	1		1				
3H32	White Mahogany	519366	6734939	41	A	17	1	1					
3H33	White Mahogany	519358	6734934	60	A	16	2		2				
3H34	White mahogany	519329	6735051		A	14	3	1	1	1			
3H35	Stag	519328	6735034	26	D	8	2	1			1		1
3H36	White Mahogany	519330	6734990		A	18	1		1				
3H37	White Mahogany	519333	6734973		A		1		1				
3H38	White Mahogany	519328	6734968	75	A	20	6					4	2
3H39	Grey Gum	519316	6734972	160	A	28	5		2	3			
3H40	Pink Bloodwood	519309	6734902	50	A		1		1				
3H41	Grey Ironbark	519279	6734890	65	A	25	2			2			
3H42	White Mahogany	519328	6735119	42	A	15	1	1					
3H43	Grey Gum	519352	6735130	45	A	14	1		1				
3H44	Grey Gum	519372	6735218	90	A	30	4		2	2			
3H45	Stag	519357	6735234	110	D	16	At least 2			At least 2			

HBT ID.	Species	Co-ordinates (GDA 1994)		Approx. DBH (cm)	Dead/ Alive	Tree Height	Functional Hollows	Position and Size of Hollows					
		Easting	Northing					Trunk - Small (<5cm)	Trunk - Medium (5-15 cm)	Trunk - Large (> 15 cm)	Limb-Small (<5cm)	Limb - Medium (5-15 cm)	Limb-Large (<15cm)
3H46	Stag	519357	6735252	46	D	10	1			1			
3H47	Grey Gum	519361	6735269	85	A	18	6	3	1	2			
3H48	Grey Gum	519382	6735307	110	A	18	3	2		1			
3H49	White Mahogany	519395	6735308	85	A	15	5	1	4				
3H50	Grey Gum	519398	6735325	90	A	20	2				2		
3H51	White Mahogany	519409	6735309	40	A	10	2					1	1
3H52	Stag	519411	6735358	100	D		1			1			
3H53	Grey Gum	519398	6735390	110	A	20	3		1	2			
3H54	Tallowood	519401	6735286	45	A	18	1	1					
3H53	White Mahogany	519407	6735306	53	A		3					2	1
3H54	Grey Gum	519428	6735288	42	A	22	1	1					
3H56	White Mahogany	519376	6735224	50	A		1					1	
3H57	Grey Gum	519403	6735179	60	A	20	3				1	1	1
3H58	Grey Gum	519341	6735172	120	A	22	10				2	7	1
3H58	Stag	519360	6735153	32	D	6	1			1			
3H59	Grey Gum	519377	6735117	130	A	25	2				2		
3H60	Grey Gum	519396	6735130	80	A	20	3				1	1	1
3H61	Tallowood	519422	6735186	43	A	20	1	1					
3H62	Tallowood	519427	6735229	65	A	22	1	1 in termite nest					
3H63	Grey Gum	519465	6735280	85	A	25	2	1	1				
3H64	Grey Gum	519516	6735318	38	A	10	1		1				
3H65	Pink Bloodwood	519525	6735321	82	A	18	4					3	1

HBT ID.	Species	Co-ordinates (GDA 1994)		Approx. DBH (cm)	Dead/ Alive	Tree Height	Functional Hollows	Position and Size of Hollows					
		Easting	Northing					Trunk - Small (<5cm)	Trunk - Medium (5-15 cm)	Trunk - Large (> 15 cm)	Limb-Small (<5cm)	Limb - Medium (5-15 cm)	Limb-Large (<15cm)
3H66	White Mahogany	519543	6735309	56	A	18	4					3	1
3H77	Stag	519549	6735309	32	D	12	3		3				
3H68	White Mahogany	519627	6735285	65	A	22	3						3
3H69	Stag	519589	6735279	45	D	15	1				1		
3H70	Grey Gum	519549	6735251	150	A	30	5				1	2	2
3H71	Grey Gum	519577	6735257	85	A	22	1				1		
3H72	Stag	519554	6735241	52	D	14	1			1			
3H72	White Mahogany	519668	6735629	105	A	20	1				1		
3H73	White Mahogany	519451	6735380	55	A	18	1					1	
3H74	White Mahogany	519414	6735409	45	A	14	1						1
3H75	Stag	519396	6735426	40	D	6	1			1			
3H76	Spotted Gum	519412	6735434	52	A	18	1		1				
3H77	White Mahogany	519441	6735450	50	A	14	1		1				
3H78	Pink Bloodwood	519452	6735456	40	A	15	1	1					
3H79	White Mahogany	519433	6735478	76	A	12	3	2	1				
3H80	Stag	519467	6735494	38	D	7	1			1			
3H81	White Mahogany	519474	6735532	70	A	16	2					1	1
3H82	Pink Bloodwood	519463	6735555	45	A		1			1			
3H83	Grey Gum	519471	6735580	110	A	30	11				3	5	3
3H84	Grey Gum	519465	6735574	110	A	30	3				1	1	1
3H85	Grey Gum	519472	6735588	100	A	28	3				1		2

HBT ID.	Species	Co-ordinates (GDA 1994)		Approx. DBH (cm)	Dead/ Alive	Tree Height	Functional Hollows	Position and Size of Hollows					
		Easting	Northing					Trunk - Small (<5cm)	Trunk - Medium (5-15 cm)	Trunk - Large (> 15 cm)	Limb-Small (<5cm)	Limb - Medium (5-15 cm)	Limb-Large (<15cm)
3H86	Stag	519479	6735638	100	D	18	7			1	1	3	2
3H87	Stag	519488	6735632	43	D	15	5				3	2	
3H88	Grey Ironbark	519509	6735629	90	A	20	2					2	
3H89	Stag	519501	6735707	130	D		14				5	4	5
3H90	Grey Ironbark	519562	6735739	90	A	20	2		1	1			
3H91	Stag	519552	6735833	75	D	17	4	1	2	1			
3H92	White Mahogany	519527	6735844	75	A	18	4	3				1	
3H93	Grey Gum	519541	6735872	120	A	25	8				2	3	3
3H94	Stag	519534	6735921	34	D	10	1			1			
3H95	White Mahogany	519541	6735900	61	A	18	1		1				
3H96	Ironbark	519560	6735896	85	A	20	1	1					
3H97	Stag	519615	6735855	65	D	12	1			1			
3H98	Stag	519744	6735905	40	D		3	1				2	
3H99	Stag	519697	6735998	42	D	11	1			1			
3H100	Stag	519671	6736160	85	D	26	4					2	2
3H102	Broad leaved paperbark	520064	6739125	120	A	17	1						1
3H103	Broad leaved Paperbark	520077	6739079	130	A	15	3	1	1	1			
3H104	Broad leaved Paperbark	520090	6739081	55	A	8	1						1
3H105	Broad leaved Paperbark	520073	6739054	120	A	10	2	1		1			
3H106	Broad leaved Paperbark	520082	6739050	95	A	8	2	1	1				
3H107	Stag	520084	6739047	50	A	6	1			1			
3H108	Stag	520112	6739006	45	D	8	1			1			

HBT ID.	Species	Co-ordinates (GDA 1994)		Approx. DBH (cm)	Dead/ Alive	Tree Height	Functional Hollows	Position and Size of Hollows					
		Easting	Northing					Trunk - Small (<5cm)	Trunk - Medium (5-15 cm)	Trunk - Large (> 15 cm)	Limb-Small (<5cm)	Limb - Medium (5-15 cm)	Limb-Large (<15cm)
3H108	Broad leaved paperbark	520055	6738761	42	A	8	1			1			
3H109	Stag	520057	6738684	30	D	6	2	1	1				
3H111	Broad leaved paperbark	520031	6738646	Split trunk- multiple stems	A	10	1				1		
3H110	Broad leaved paperbark	520027	6738648	40	A	6	3	3					
3H112	Broad leaved Paperbark	520058	6738579	45	A	10	1	1					
3H113	Broad leaved paperbark	520060	6738566	45	A	12	1			1			
3H114	Broad leaved paperbark	520063	6738559	80	A	15	5		2		3		
3H115	Brushbox	520011	6740019	110	A	20	2	1					1
3H116	Grey Gum	520010	6740038	90	A	20	1						1
3H117	Bloodwood	520275	6740499	48	A	24	1				1		
3H118	Stag	520283	6740569	45	D	14	3				1	1	1
3H119	Swamp Box	520351	6740588	50	A	18	1				1		
3H120	Willow Bottlebrush	520360	6740589	30	A	12	1	1					
3H120	Bloodwood	520415	6740651	120	A		1						1
3H121	Tallowwood	520461	6740691	45	A	15	1					1	
3H122	Forest Red Gum	520869	6740999	90	A	23	1					1	
3H129	Broad leaved paperbark	522365	6742670		A		1						1
3H130	Broad leaved paperbark	522372	6742658	60	A	15	2	1	1				
3H131	Broad leaved paperbark	522402	6742609	90	A	20	1		1				
3H132	Broad leaved paperbark	522406	6742594	45	A	15	1				1		

HBT ID.	Species	Co-ordinates (GDA 1994)		Approx. DBH (cm)	Dead/ Alive	Tree Height	Functional Hollows	Position and Size of Hollows						
		Easting	Northing					Trunk - Small (<5cm)	Trunk - Medium (5-15 cm)	Trunk - Large (> 15 cm)	Limb-Small (<5cm)	Limb - Medium (5-15 cm)	Limb-Large (<15cm)	
3H132	Swamp Oak	523137	6743656	Split 40/60	A	10	2		2					
3H133	Swamp Oak	523533	6743993	50	A	8	1					1		
3H134	Swamp Oak	523193	6743085	120	A	14	2	1	1					
3H160	Grey Mangrove	524485	6751315	42	A	15	2	1	1					
3H161	Grey Gum	523922	6753192	100	A	19	3				2	1		
3H162	Stag	524313	6752814	30	D	8	1					1		
3H163	Bloodwood	524314	6752807	110	A		1					1		
3H164	Bloodwood	524338	6752807	90	A		1					1		
3H165	Grey Gum	524299	6752714	120	A	20	2				1	1		
3H166	Grey Gum	524313	6752675	45	A	18	1				1			
3H167	Grey Ironbark	524245	6752202	110	A	15	2		2					



Appendix C

Hollow Obligated Fauna Likely to Occur within the Locality

Table B1 Hollow-obligated Fauna Likely to Occur within the Locality

<i>Common Name</i>	<i>Scientific Name</i>	<i>Comments</i>
Birds		
Australian Wood Duck	<i>Chenonetta jubata</i>	Confirmed on site
*Glossy Black Cockatoo	<i>Calyptorhynchus lathami</i>	
Yellow-tailed Black Cockatoo	<i>Calyptorhynchus funerus</i>	
Galah	<i>Cacatua roseicapilla</i>	
Long-billed Corella	<i>Cacatua tenuirostris</i>	
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	
Scaly-breasted Lorikeet	<i>Trichoglossus chlorolepidotus</i>	Confirmed
Musk Lorikeet	<i>Glossopsitta concinna</i>	
*Little Lorikeet	<i>Glossopsitta pusilla</i>	
Australian King Parrot	<i>Alisterus scapularis</i>	Confirmed
Eastern Rosella	<i>Platycercus eximius</i>	Confirmed
*Powerful Owl	<i>Ninox strenua</i>	
*Sooty Owl	<i>Tyto tenebricosa</i>	
*Masked Owl	<i>Tyto novaehollandiae</i>	
Southern Boobook	<i>Ninox novaeseelandiae</i>	
Barn Owl	<i>Tyto alba</i>	
Owlet-Nightjar	<i>Aegothesles cristatus</i>	
White-throated Nightjar	<i>Eurostopodus mystacalis</i>	
Tawny Frogmouth	<i>Podargus strigoides</i>	
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Confirmed
Sacred Kingfisher	<i>Todiramphus sanctus</i>	
Dollarbird	<i>Eurystomus orientalis</i>	
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	
Striated Pardalote	<i>Pardalotus striatus</i>	
Starling	<i>Sturnis vulgaris</i>	
Common Myna	<i>Acridotheres tristis</i>	
Reptiles		
Lace Monitor	<i>Varanus varius</i>	Confirmed
Carpet Python	<i>Morelia spilota</i>	Confirmed
Amphibians		
Green Tree Frog	<i>Litoria caerulea</i>	
Bleating Tree Frog	<i>Litoria dentata</i>	Confirmed
Perons Tree Frog	<i>Litoria peronii</i>	
Tylers Tree Frog	<i>Litoria tyleri</i>	
Mammals		
Brown Antechinus	<i>Antechinus stuartii</i>	
*Brush-tailed Phascogale	<i>Phascogale tapofata</i>	Confirmed in Tyndale area by <i>Bushfire Safe P/L</i>
Mountain Brushtail Possum	<i>Trichosurus caninus</i>	
Common Brushtail Possum	<i>Trichosurus vulpecular</i>	

<i>Common Name</i>	<i>Scientific Name</i>	<i>Comments</i>
Feather-tail Glider	<i>Acrobates pygmaeus</i>	
Sugar Glider	<i>Petaurus breviceps</i>	
*Squirrel Glider	<i>Petaurus norfolcensis</i>	
*Yellow-bellied Glider	<i>Petaurus australis</i>	
Greater Glider	<i>Petauroides volans</i>	
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	
*White-striped Mastiff Bat	<i>Tadarida australis</i>	
*Eastern Free-tail Bat	<i>Mormopterus norfolkensis</i>	
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	
Eastern Forest Bat	<i>Vespadelus pumilis</i>	
Little Forest Bat	<i>Vespadelus vulturnus</i>	
Southern Forest Bat	<i>Vespadelus regulus</i>	
*Southern Myotis	<i>Myotis macropus</i>	Confirmed
*Greater Broad-nosed Bat	<i>Scoteanax reupellii</i>	
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>	
Lesser Long-eared Bat	<i>Nyctophilus geoffreyi</i>	
Gould's Long-eared Bat	<i>Nyctophilus gouldii</i>	

* Species listed as threatened under the TSC Act and/ or EPBC Act.